CHAPTER 3

3 AFFECTED ENVIRONMENT

To determine whether the various component options would have a substantial effect on the human environment, an accurate understanding of the environment as it exists before the project is developed is necessary. This chapter describes, on a resource-by-resource basis, the existing environment that would be affected if the project proceeds.

FGMI, and its predecessors, have conducted environmental baseline analyses for many resources in the True North Mine area. The information contained in this chapter is drawn from those analyses, which are referenced appropriately and available for review, and from other relevant literature. Because of the juxtaposition of the True North and Fort Knox mines, much of the baseline analyses done for the Fort Knox NEPA and permitting processes is relevant also to these same True North processes. Thus, FGMI's Fort Knox Mine EA (FGMI, 1993) and associated studies are referenced frequently below.

Unlike mining projects located in remote areas with no human development nearby, the True North prospect has a past mining history and is adjacent to some active nonmining human activities and development.

3.1 GEOLOGY AND PHYSIOGRAPHY

3.1.1 REGIONAL GEOLOGY

The True North deposit is located within the Yukon-Tanana Terrane, which is bounded on the northeast by the Tintina Fault and on the southwest by the Denali Fault. The Yukon-Tanana Terrane consists of accreted metamorphic rocks of primarily sedimentary origin that were subjected to greenschist, amphibolite, and eclogite-facies grade metamorphism. Intermediate to felsic plutons and stocks intruded the metamorphic rocks during the Cretaceous Period (85 – 95 million years ago) (FGMI, 1993).

The Yukon-Tanana metamorphic rocks, within the Fairbanks Mining District, are primarily composed of the Chatanika Terrane and the Fairbanks Schist. The Chatanika Terrane is postulated to have been thrust over the Fairbanks Schist prior to retrograde metamorphism of both units to greenschist facies and the Cretaceous intrusive activity. High angle northeast striking faults transect the district and offset all rock types (FGMI, 1993). For a more detailed discussion of regional geology see WMCI (2000).

3.1.2 TRUE NORTH DEPOSIT GEOLOGY

The True North property is bisected by the high angle northeast striking Eldorado Fault that emplaced the Fairbanks Schist, in a high angle contact with the allochthonous Chatanika Terrane. The True North deposit occurs in a structurally complex mineralized zone within the Chatanika Terrane, parallel to the Eldorado Fault. Ore zones are typically gently dipping, variably brecciated zones that may be related to regional thrust faulting. The thickness and shape of the breccia zones are widely variable and appear to have been modified by higher angle faults (FGMI, 2000a).

Calcareous and carbonate-altered schist of the Chatanika Terrane hosts the True North deposit. These rocks have been subdivided into three main lithologic subunits: (1) a slate unit consisting of slate and fine-grained carbonaceous quartzite; (2) a mafic schist unit consisting of chlorite-biotite-amphibole schist, eclogite, amphibolite, and marble; and (3) a felsic unit consisting of muscovite schist, quartz-muscovite-biotite schist, and quartzite. The felsic and mafic schist units are the main hosts for gold at True North (FGMI, 2000a).

Fine-grained gold is closely associated with pyrite, arsenopyrite, and (less directly) stibnite in the unoxided portion of the True North deposit. Gold occurs in drusy quartz veins and altered and brecciated schist adjacent to the quartz veins. The most intensely mineralized zones are graphitic breccias with numerous quartz–carbonate-sulfide veins. Less intensely mineralized zones contain fewer quartz veins in variably brecciated, iron carbonate and calcium carbonate altered schist. Weakly mineralized to unmineralized zones are calcite-altered and are locally brecciated (FGMI, 2000a).

The True North ore body is elongated northeast gently dipping to the southwest. The estimated reserves for the True North Hindenburg and East pits are 7.4 million tons, averaging 0.063 oz/t. For a more detailed description of the deposit's geology see WMCI (2000).

3.1.3 Physiography

Topography of the project area consists of rounded, even-topped ridges with gentle slopes (Fig. 1.2-2). Ridge-crest altitudes range from 1,500 to 2,600 feet on Pedro Dome and rise 500 to 1,500 feet above valley floors (Haugen et al., 1982). Hillsides in the project area frequently are characterized by slopes of 10 to 30 percent, and approach 50 percent on the northwest flank of Pedro Dome.

Drainage patterns of the project area watersheds are dendritic. South and southwest of the deposit drainage is into Murray Creek, a tributary of Dome Creek. On the west and northeast of the deposit drainage is into Spruce Creek, and Whiskey Gulch and Louis Creek, respectively, all tributaries of Little Eldorado Creek to the north.

3.2 Soils and Permafrost

3.2.1 Soils

Soils in the project area vary according to their position in the landscape and the occurrence of permafrost. Two broad geographic landform types exist, mountain slope and floodplain.

The poorly drained soils in the valley bottoms and on the northern exposures of the project area usually are underlain by discontinuous permafrost. Mountain slope soils have developed in loess. Accumulation of loess is more prevalent on gently climbing toe slopes with southerly exposures than on steeper northerly exposures. The loess cap is generally thicker in the toe slope position than on the ridge tops (FGMI, 1993).

Soils on floodplains have developed in sandy or silty alluvium. This material has a mixed origin, which includes loess from distant glacial sources and bedrock materials from adjacent uplands. In general, near stream channels, soils are sandy in texture and the permafrost is deep or absent. Farther from the stream channel, soils become progressively more silty in texture and permafrost is closer to the surface (FGMI, 1993).

On the mountain sides, permafrost occurs on the north-facing slopes of ridges and in the sloping valleys along secondary drainages. Large areas of soil on floodplains also can be underlain by permafrost. If the insulating moss layer or litter is removed on permafrost soils, the overlying soil may subside. In summer, soils with shallow permafrost typically are saturated to near the mineral soil surface. Frost heaves and differential soil subsidence following surface disturbance are hazards (FGMI, 1993).

Overall, the soil mantle in the project area is shallow, with bedrock or weathered bedrock usually present within 50 cm of the soil surface. Upland soils found in broadleaf forest and shrub communities are characterized by relatively thin organic layers (2-14 cm) over a silt loam or sandy-silt loam. Charcoal fragments are common in the upper mineral soil horizon; drainage generally is moderate to good. Upland black spruce communities are found on soils distinctly different from other upland vegetation types (Roth and Kidd, 1996).

All sites ground truthed by Roth and Kidd (1996) and classified as wetland had soils that were saturated. Soil pits dug at the base of drainages rapidly filled with water. At higher elevations water either seeped from the walls of the pits or could be shaken readily from the soil matrix. No histosols, i.e., organic horizons $\geq$ 40 cm, were recorded in sample pits, but organic horizons ranged from 8 to 33 cm. Mineral soils were silt or silt loam, with large coarse fragments and mottling. Drainage ranged from imperfect to very poor, and low chroma matrices were typical.

Further descriptions of soils in the project area may be found in Kidd and Rossow (1996), Kidd and Pullman (1997), Pullman and Kidd (1998).

3.2.2 PERMAFROST

3.2.2.1. REGIONAL CONDITIONS

The International Permafrost Association (IPA, 1998) defines permafrost as "ground (soil or rock and the included ice and organic matter) that remains at or below 0°C for at least two consecutive years". Therefore, permafrost is characterized by measurement of subsurface temperatures (WMCI, 2000).

Permafrost in the project area is discontinuously distributed, and thus the interaction between permafrost and shallow groundwater is complex. Groundwater may occur above, below, and adjacent to frozen subsurface zones, as wells as within (or penetrating through) the permafrost itself. The presence of permafrost can control the movement of groundwater because of its impermeability. In a discontinuous permafrost environment, permafrost may be present or absent due to a variety of factors, including human and natural disturbances of the terrain and vegetation, local climate variations, and general aspect of the area (i.e., north facing slopes) (WMCI, 2000).

Permafrost exists at various depths throughout the Fairbanks area (Lawson, et. al, 1996). The top of the permafrost ranges from approximately 2 ft to over 50 ft deep. The thickest thawed zones generally occur beneath swales or former stream channels, roads, buried pipelines, building and building excavations, and other areas where vegetation has been cleared. The bottom surface of the permafrost generally ranges from 30 ft to over 160 ft deep. Areas of minimum permafrost thickness occur in areas adjacent to non-permafrost zones while maximum thickness occurs generally in low-lying areas with south facing aspects. The top and bottom surfaces of the permafrost can have highly irregular relief (WMCI, 2000).

Characterization of the three-dimensional distribution of permafrost is difficult and complex. Transitions from unfrozen to frozen zones can be abrupt with little or no surface expression. Vegetative zones are generally heavily influenced by permafrost because the presence of frozen ground can restrict drainage and helps to maintain cool soil temperatures. Low soil temperatures, in turn, slow the breakdown of organic materials and help establish conditions that create and maintain wetland communities (Newmont, 1997).

In general, the presence of permafrost can be inferred from a variety of wetland vegetative types, including dwarf black spruce woodland and black spruce scrub. Upland vegetative types, including closed broadleaf or closed mixed forest types, are often indicative of the absence of permafrost (WMCI, 2000).

3.2.2.2. SITE CONDITIONS

Surface vegetation and wetland areas -- A variety of studies in the Fairbanks area has shown that general correlations can be made between surface vegetation and wetland types and the presence of permafrost (Lawson, et. al, 1996; Jorgenson, et. al., 1999; Golder, 2000). In general, the presence of permafrost results in restricted drainage and cool soil temperatures, while the absence of permafrost can result in well-drained conditions. The resulting variations in vegetation and wetlands ecosystems can be used to assess the potential presence of permafrost.

The following general relationships apply for the correlation of permafrost and vegetative types (Lawson, et. al., 1996):

Upland vegetative zones, such as closed or open broadleaf (consisting primarily of birch and aspen) or closed mixed forest (mixed broadleaf and larger needleleaf varieties [consisting of white spruce and large black spruce]) are associated with well drained conditions and are indicative of the absence of permafrost or deep thaw depths.

Various lowland vegetative zones, including wetlands consisting of dwarf black spruce woodland and shrub, are associated with poor drainage and are indicative of the presence of permafrost.

Riverine vegetative zones that are associated with larger flood plains and rivers generally indicate the absence of permafrost. Groundwater is thought to discharge primarily within these areas.

Wetlands in the vicinity of the mine site are discussed in detail in Section 3.9 (Wetlands). Figure 3.9-1 in that section presents a map of wetland vegetation types on the True North mining claims. The upland vegetative zone is present over large areas of the ridge top and along south facing slopes, makes up approximately 60 percent of the immediate site area. Permafrost is likely absent throughout these areas. Lowland vegetative types, including dwarf black spruce forest and scrub areas, are present along north facing slopes and within the primary drainages. These zones are likely underlain by permafrost of various thicknesses and thaw depths. There are no riverine vegetative zones in the immediate project area (WMCI, 2000).

Impact of permafrost on groundwater flow -- The presence of permafrost has an impact on both shallow and deep groundwater flow. At the True North site, shallow groundwater is generally isolated to areally limited thaw zones above the permafrost. Significant shallow flows were encountered in a single location during exploration drilling. Flows of around 1 gpm were noted at depths of 25 to 30 ft. The flows were likely a result recent infiltration from snowmelt and spring rains in the vicinity of the boring. A review of all geologic borings in the vicinity indicated that shallow flow was encountered in one other boring. None of the other borings within 300 ft encountered shallow flows. The depths to first water ranged from 120 to more than 280 ft in these borings. This suggests that the shallow flow observed is likely representative of an isolated, areally limited flow zone perched on top of permafrost in this area (WMCI, 2000).

The main groundwater flow system at True North is deeper, occurring at depths ranging from 120 to over 300 ft deep. This system occurs below permafrost in areas underlain by permafrost, and at depth in areas where permafrost is absent (WMCI, 2000).

3.3 Geotechnical and Seismic Considerations

Although Fairbanks does not lie directly on any of the identified major fault systems, it does have several east-west trending fault systems passing near it, including the Denali. A list of known major statewide earthquakes from 1786 to 1970 shows 19 of 222 earthquakes, or almost 9 percent of the total, occurred in the immediate Fairbanks area (Hays, 1980).

The historical record shows seismic events measured to Mercalli Intensity VIII (approximately Richter magnitude 6 to 6.5) in the Fairbanks area, and a substantial concentration of Intensity VII to IX (Richter magnitude 5.5 to 6.7) events occurred in interior Alaska (Hays, 1980). This trend is evident in the 1971-to-1980 time frame as well, with a marked concentration of Intensity V and VI events having occurred in the immediate project vicinity.

The 1997 Uniform Building Code (UBC) places the project site firmly in Seismic Zone 3, a high-risk zone (UBC, 1997). The 1990 Minimum Design Loads for Buildings and Other Structures (American National Standards Institute [ANSI] AS 8.51), now known as ASCE 7-88, generalized the boundaries, but still places Fairbanks well into Zone 3 (America North, Inc., 1991b).

3.4 Climate

3.4.1 Temperature

The climatic conditions of the Fairbanks area are characterized by typical interior Alaskan conditions, with short warm summers and long cold winters. Diurnal temperature fluctuations can be very large and are driven by the vast change of sunlight occurring throughout the year. The area receives about 18 to 21 hours of sunlight per day during June and July, and only 4 to 10 hours of sunlight per day during November through March. The Fairbanks Weather Service Office reports that systematic differences exist between recorded temperatures in Fairbanks and in the mountains to the north and east of town. The regions to the north and east of Fairbanks are cooler during the summer and warmer during the winter. For the region, December and January are the coldest months while temperatures reach their annual peaks in July. Summer temperature fluctuations are comparatively low, ranging between 30° and 90°F, while winter temperatures fluctuate between –65° and 45°F (WMCI, 2000).

Table 3.4-1 summarizes monthly average temperatures for the climatological stations reviewed for the baseline study. Data from the Fort Knox Mine are only available for the period between 1990 and 1994. The Ridge Station at the mine is likely most similar to conditions at True North. Based on these records, the average annual temperature near the project area was 32.3°F. These temperatures are slightly warmer than the regional long-term average at other nearby stations, but represent only a few years of data (WMCI, 2000).

Review of the climatic data available indicate that the Gilmore Creek Station, with its proximity to the project area, similar elevation, and 37-year period of record is likely most representative of longer-term climatic conditions at the True North project area. The yearly average temperature at the Gilmore Creek Station is 25.3°F. A summary of the average monthly temperatures adopted for the True North project is included in Table 3.4-1 (WMCI, 2000).

3.4.2 PRECIPITATION

Precipitation in the Fairbanks area is affected by two distinct physiographic regions: the Tanana Flats to the south and the Yukon-Tanana Uplands to the north. Annual precipitation in the Tanana Flats area is approximately 10 inches per year, whereas the total in the uplands area is approximately 20 inches per year (America North, 1992). Higher precipitation in the uplands is due to orographic effects, stronger summer storms, and higher overall snowfall rates. The True North site is located within the upland area and would be expected to have higher overall precipitation rates than the Fairbanks area (WMCI, 2000).

Table 3.4-1

Summary of regional mean monthly temperatures (°F)

Station	Period of record	Longitude (ddd-mm)	Latitude (dd-mm)	Elevation (ft-msl)	Month Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Fairbanks WSO (#502968)	1961-	147-52	64-49	440	-10.1	-3.6	11.0	30.7	48.6	59.8	62.5	56.8	45.5	25.1	2.7	-6.5	26.9
College Univ. (#509641)	1961-	147-52	64-51	480	-7.0	-0.8	14.1	30.8	47.7	58.4	61.2	56.1	45.1	25.4	4.0	-4.6	27.5
College Observatory (#502107)	1961-	147-50	64-52	620	-6.1	-0.7	13.2	30.1	47.4	58.3	61.0	55.8	44.6	24.8	4.4	-3.5	27.4
Gilmore Creek (#503275)	1962-	147-31	64-59	970	-9.4	0.8	10.9	28.5	43.9	54.5	57.3	52.9	42.5	22.0	4.6	-4.9	25.3
Chena Hot Springs (#501574)	1962-	146-03	65-03	1200	-13.7	-3.3	8.3	25.2	41.4	53.2	55.8	51.2	41.0	20.4	0.3	-6.7	22.8
Fort Knox Mine (Ridge station)	1992-			1955	4.5	8.0	17.5	34.0	48.0	55.5	60.3	53.3	35.7	24.5	14.3	9.5	32.3
Fort Knox Mine (Valley station)	1990-			1386	5.0	0.8	13.6	29.2	48.2	56.7	58.7	52.4	35.5	19.0	5.8	0.7	29.5
True North Project (Newmont station)	1995-			~1500	-0.9	18.8	14.8	30.4	47.8	61.9	62.7	51.6	47.8	20.5	13.9	2.0	30.9
Regional average					-4.7	2.5	12.9	29.9	46.6	57.3	59.9	53.8	42.2	22.7	6.3	-1.8	27.8
Adopted Baseline Temperature					-9.4	0.8	10.9	28.5	43.9	54.5	57.3	52.9	42.5	22.0	4.6	-4.9	25.3
Site Average					2.9	9.2	15.3	31.2	48.0	58.0	60.6	52.4	39.7	21.3	11.3	4.1	30.9

A summary of precipitation data from nearby stations is presented in Table 3.4-2. Based on these data, the regional average annual precipitation is approximately 12.9 inches. However, as noted above, the uplands area of the True North project area will generally experience higher annual precipitation totals. As shown in Table 3.4-2, only a short period of record is available at stations similar in location and elevation (i.e. Fort Knox Mine and True North stations). However, review of these data during months with overlapping records indicates that precipitation at each of these stations is similar to that recorded at the Gilmore Creek station (WMCI, 2000).

Because of its period of record (37 years), the Gilmore Creek station most likely represents the long-term precipitation trends at the True North project area. Based on the Gilmore Creek data, the majority (approximately 60 percent) of the precipitation in the project area occurs during the summer and early fall between the months of June and September. The maximum monthly precipitation occurs in July (averaging 3.0 inches) and the minimum monthly precipitation occurs in March (averaging 0.3 inches). The long-term average annual precipitation at the Gilmore Creek station is 14.6 inches per year. This value may be somewhat low for the project area, based on the expected 20 inches a year for upland areas. A summary of the average monthly precipitation adopted for the True North project is included in Table 3.4-2 (WMCI, 2000).

3.4.3 EVAPORATION

Significant evaporation occurs only during the summer months due to low values of solar radiation during the winter months. Evaporation data gathered from the College University Experiment Station are the only record of evaporation in the True North project vicinity. Pan evaporation records are available but are missing several days of measurement.

Table 3.4-3 shows a summary of the mean pan evaporation for each month. Average annual evaporation is approximately 18 inches per year, all occurring between June and September. The maximum evaporation occurs during June, averaging 5.04 inches per month (WMCI, 2000).

3.5 SURFACE WATER HYDROLOGY

WMCI (2000) described the surface water hydrology of the project area, which lies within the drainage area of the Chatanika River. The northern area of the site drains to Little Eldorado Creek and includes the tributaries of Last Chance Creek, Louis Creek, Discontented Pup, Whiskey Gulch, and Spruce Creek (Fig. 1.2-2). The southern area drains into Dome Creek, primarily via the tributary of Murray Creek. Table 3.5-1 shows the drainage area and average slope for each channel. The South Fork of Spruce Creek and Upper Louis Creek recorded low flows of less than 0.001 cfs and were deemed ephemeral streams. Lower Spruce Creek, Whiskey Gulch, and Murray Creek approached base flow conditions and are expected to be perennial streams. The hydrographs showed several spiked readings caused by large precipitation events, and recorded flows as high as 1.4 cfs in Lower Spruce Creek in September of 1995.

Table 3.4-2

Summary of regional monthly mean precipitation (inches)

Station	Period of record	Long (ddd-mm)	Lat (dd-mm)	Elev (ft-msl)	Month												
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Fairbanks WSO Airport (#502968)	1961-1990	147-52	64-49	440	0.5	0.4	0.4	0.3	0.6	1.4	1.9	2.0	1.0	0.9	0.8	0.9	10.9
College Univ. Experiment (#509641)	1961-1990	147-52	64-51	480	0.5	0.4	0.4	0.3	0.6	1.6	2.2	2.3	1.1	0.9	1.5	0.9	12.7
College Observatory (#502107)	1961-1990	147-50	64-52	620	0.5	0.5	0.4	0.3	0.6	1.6	2.1	2.3	1.1	1.0	0.9	0.9	12.1
Gilmore Creek (#503275)	1962-1999	147-31	64-59	970	0.4	0.3	0.3	0.5	1.0	1.9	3.0	2.9	1.5	1.0	1.0	0.9	14.6
Chena Hot Springs (#501574)	1962-1978	146-03	65-03	1200	0.5	0.4	0.7	0.5	0.7	2.1	2.7	3.1	1.2	0.9	0.8	0.8	14.4
Fort Knox Gold Mine (Admin. Station)	1997-1999				0.5	0.4	0.5	0.5	0.8	2.0	2.8	3.0	1.4	1.0	0.9	0.9	14.5
True North Project Area (Newmont Station)	1995-1998			~1500	0.3	0.6	0.4	0.2	0.3	1.5	1.7	2.9	1.1	1.1	0.4	0.4	11.0
Regional average					0.4	0.4	0.5	0.4	0.6	1.7	2.3	2.6	1.2	1.0	0.9	0.8	12.9
Adopted Baseline Precipitation					0.4	0.3	0.3	0.5	1.0	1.9	3.0	2.9	1.5	1.0	1.0	0.9	14.6

Table 3.4-3
Summary of regional mean pan evaporation rates (inches)

Station	Period of record	Long (ddd-mm)	Lat (dd-mm)	Elev (ft-msl)	Month												
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
College Univ. Experiment (#509641)	1931-99	147-52	64-51	480	0.00	0.00	0.00	0.00	4.25	5.04	4.56	2.82	1.38	0.00	0.00	0.00	18.05

Table 3.5-1
Summary of watershed characteristics for True North project area creeks

Channels 2nd Order	1st Order	Drainage Area (acres)	Length (ft)	Upper Elev (ft)	Lower Elev (ft)	Average Slope (ft/ft)
Eldorado Creek		4875	12375	855	645	0.0170
	Marshall Gulch	555	11220	1740	760	0.0873
	Whiskey Gulch	244	2640	1120	810	0.1174
	Discontented Pup	110	7260	1280	815	0.0640
	Louis Creek	691	4290	1080	855	0.0524
	Last Chance Ck	1891	10560	1940	855	0.1027
	Spruce Creek	1924	11880	1020	640	0.0320
Dome Creek		7967	35223	1739	574	0.0326
	Murray Creek	584	5280	1080	820	0.0492

There are five USGS gauging stations within a 25-mile radius of the project area: Caribou Creek near Chatanika (#15535000), Little Chena River near Fairbanks (#15511000), Chena River at Fairbanks (#15514000), Poker Creek near Chatanika (#15534900), and Chena River near Two Rivers (#15493000). The gauging stations are all part of the Tolovana River and Chena River Basins.

Caribou Creek has similar characteristics to the Little Eldorado Creek including slope, drainage area, and riparian zone**.** Figure 3.5-1 is a hydrograph of the historical daily streamflows at the Caribou Creek gauging station. The Caribou Creek drainage represents a good analog of potential flow conditions in the Little

Eldorado Creek and Dome Creek drainages near the True North site (Halepaska, 1992). Water balance data collected at the Fort Knox Mine confirm that Caribou Creek characteristics can be used as a reasonable representation of flow conditions in areas local to the True North project area.

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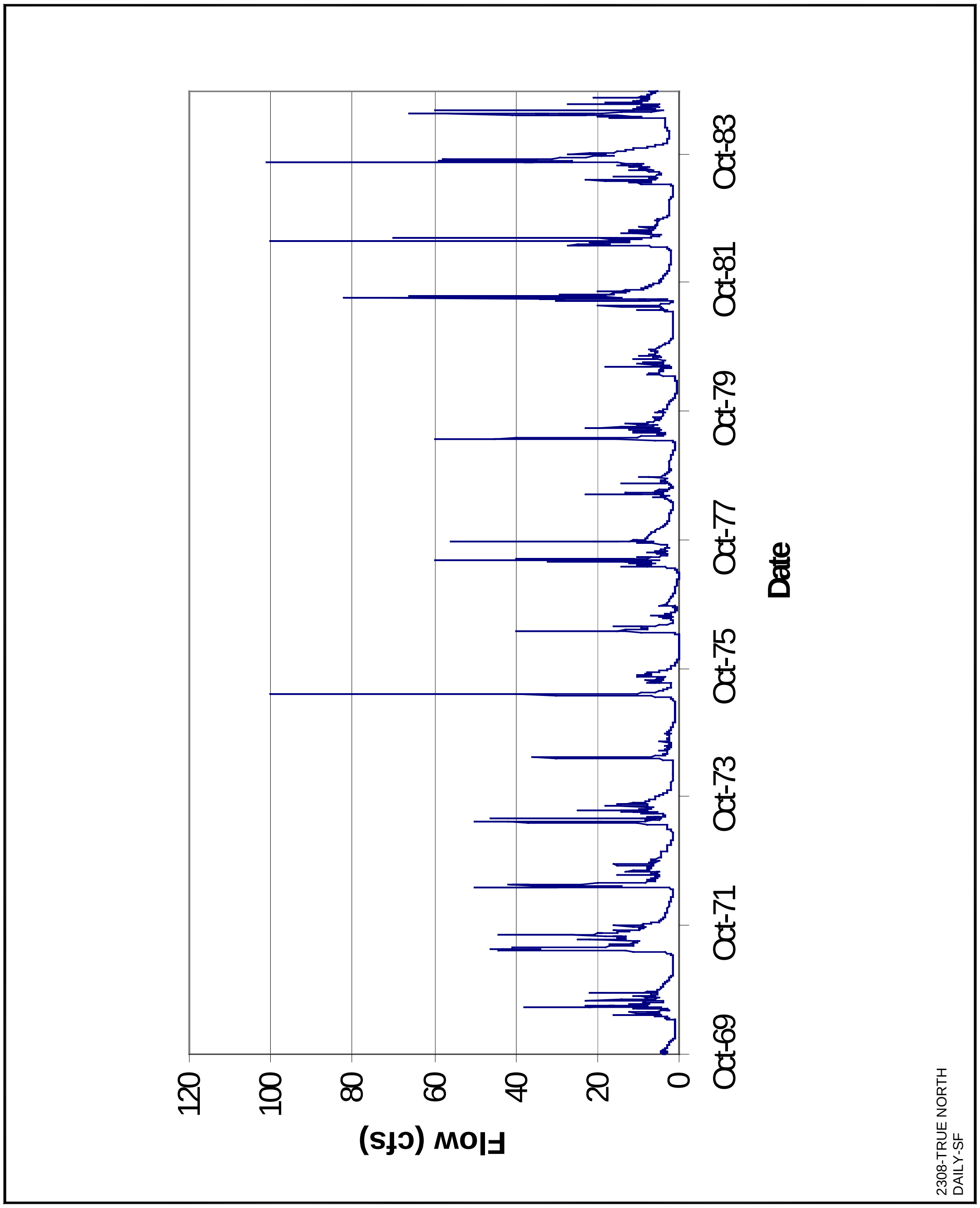
Figure 3.5-1 Historical daily streamflows at Caribou Creek



3.6 GROUNDWATER HYDROLOGY

3.6.1 REGIONAL GROUNDWATER CONDITIONS

Regional groundwater flow is heavily influenced by the presence of permafrost. Because of its low permeability, permafrost has a large impact on groundwater flow in terms of potentially restricting lateral flow, and focusing recharge and discharge zones in areas where permafrost is absent. Key components of regional groundwater flow in a discontinuous permafrost environment include:

Groundwater flow above the permafrost (suprapermafrost groundwater) is likely highly localized and discontinuous.

Groundwater flow below the permafrost (subpermafrost groundwater) represents the primary regional flow system and may occur under both unconfined and confined conditions.

Recharge to deep groundwater occurs through zones where permafrost is absent over extensive areas (such as south facing slopes or hilltops) or taliks (unfrozen zones in permafrost areas).

Recharge to the regional groundwater flow system is primarily sourced by snowmelt during the late spring. Recharge potential during the summer is generally low due to relatively high soil moisture storage potential during the primary evaporation season, and the fact that summer rainfall in the Fairbanks area is generally of low intensity and short duration. Enhanced infiltration could occur during very wet summer rainfall events.

Discharge of deep groundwater likely occurs primarily along stream courses or in lakes that penetrate the permafrost. Discharge can also occur as springs or seeps within drainages and along hill slopes where permafrost is discontinuous (WMCI, 2000).

These key components of regional groundwater flow are summarized on a conceptual cross-section, shown in Figure 3.6-1 (after Kane, 1981).

3.6.2 MINE AREA GROUNDWATER CONDITIONS

Data on long-term fluctuations in groundwater elevation within the main flow system at the site are available from two piezometers installed by Newmont, TN-182 and TN-281. Monthly water level measurements from these piezometers were collected from November 1994 through November 1998, and are shown on Figure 3.6-2. TN-281 is located along the ridge line between the Dome Creek and Little Eldorado Creek drainages, in a zone of upland vegetation where permafrost is interpreted to be absent. Water levels in this piezometer show a general decline between 1994 and 1998 from a maximum elevation of 1,626 ft to 1,564 ft above mean sea level (amsl), with the piezometer drying out in May 1998. A general seasonal trend in water levels is noted in this piezometer, with water levels rising during the late summer/early fall period, and then declining during the remainder of the year. This seasonal fluctuation included water fluctuations of up to 35 ft during 1995, with a longer term decline of approximately 62 ft between October 1995 and May 1998 (WMCI, 2000).

Piezometer TN-182 is located on a hill slope above Murry Creek, and is in an area with lowland vegetation that is likely underlain by permafrost. Water levels in this piezometer had much smaller fluctuations, but with generally the same trends as observed in TN-281. Water levels in TN-182 declined from a maximum of 1,123 ft amsl during 1995 to a low of 1,117 ft amsl in November 1998. Minor seasonal fluctuations are evident in the water levels, with a slight rise in water levels during summer 1995, followed by a long-term decline (WMCI, 2000).

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Figure 3.6-1 Conceptual cross section of permafrost conditions and groundwater flow

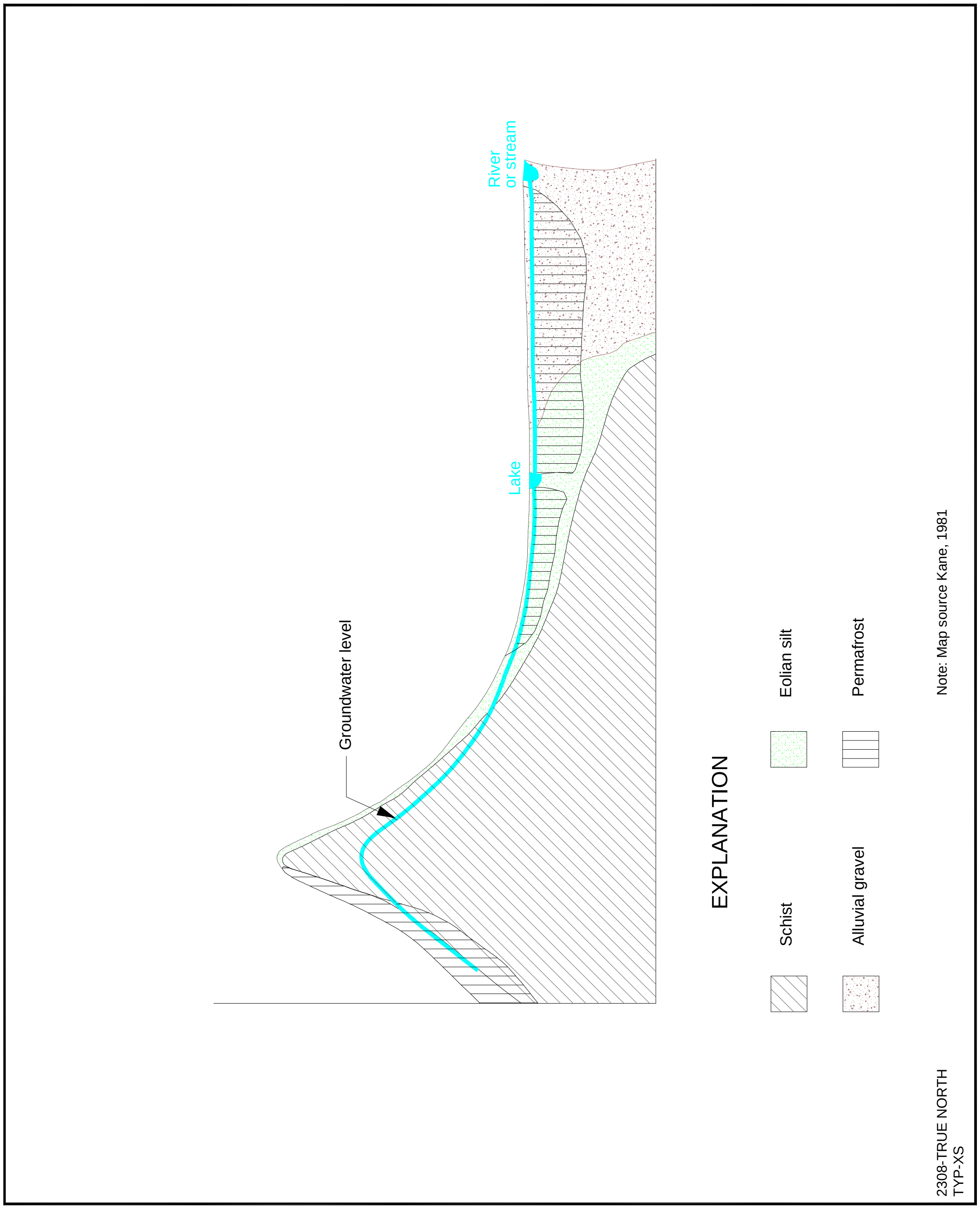

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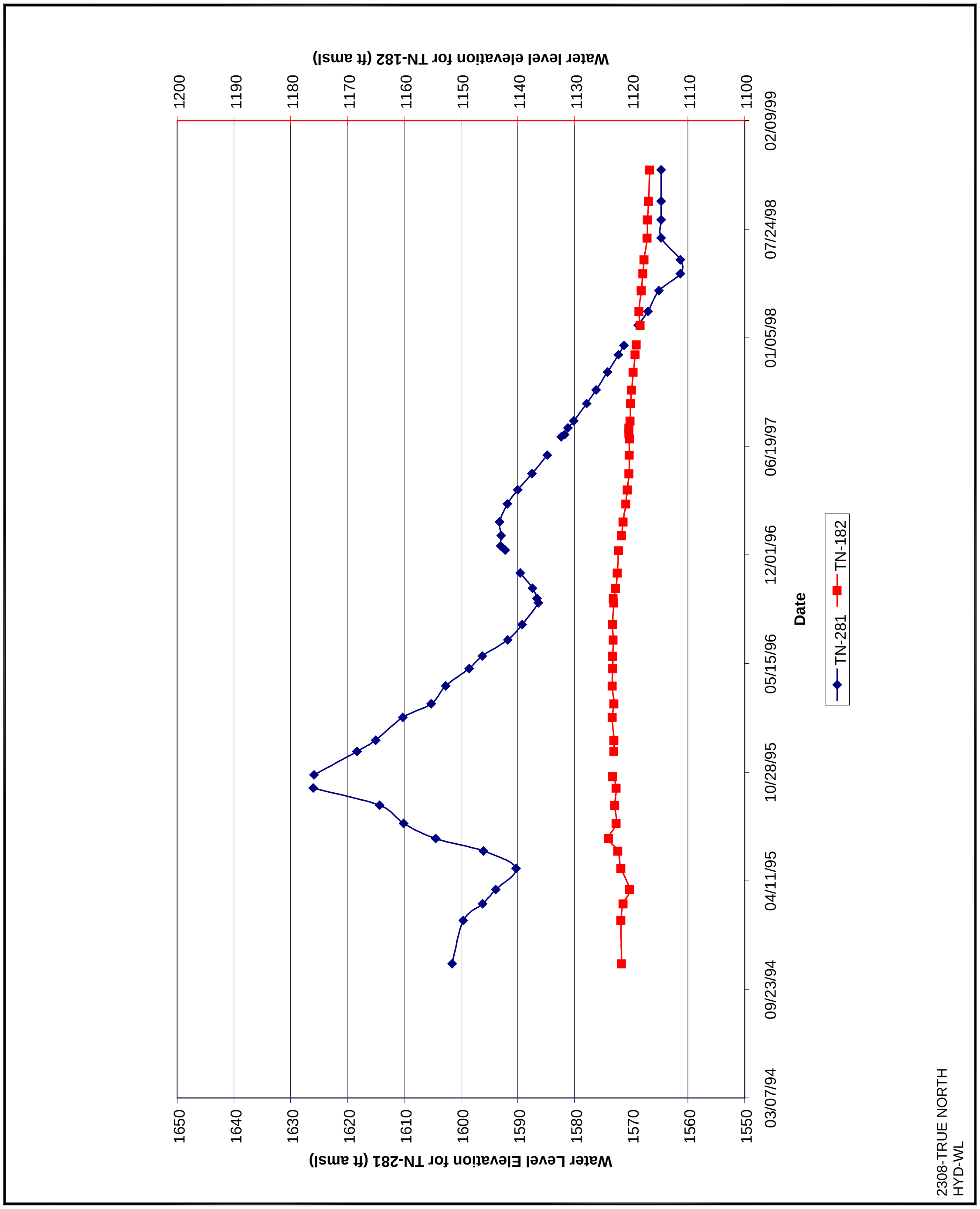
Figure 3.6-2 Hydrograph showing historic water levels in TN-182 and TN-281



Based on a review of available long-term water level data, the following conclusions can be made:

Water levels in TN-281 are representative of a relatively low permeability fractured-rock system. The magnitude of the water level changes, suggest active recharge to a fracture system through unfrozen rock material. The seasonal infiltration of water fills discrete fracture zones, resulting in the observed large increase in water level in the piezometer. The fractures then slowly drain as groundwater discharges into downgradient stream areas.

Water levels in TN-182 are representative of groundwater flow isolated below permafrost that does not receive direct seasonal recharge. Water levels below permafrost do not fluctuate significantly, but do follow the general system trends.

The long-term decline in water levels noted in both wells is likely due to dryer than average conditions noted for the area during the 1994 – 1998 period.

Water levels from the nine newly installed monitoring wells have been collected monthly since December 1999. Water within three of the monitoring wells froze shortly after installation (MW-1, MW-4, and MW-5), likely due to permafrost or frozen ground surrounding the wells. Water levels in all of the other 7 monitoring wells showed a general decrease between January and June 2000. Water level declines ranged from less that 1 ft in MW-9 to almost 5 ft in MW-8. Monthly monitoring of water levels is ongoing such that seasonal trends can be observed and characterized (WMCI, 2000).

Based on these piezometric data, groundwater is interpreted to flow to the north, northeast, and northwest off the divide between the Dome Creek drainage and the Little Eldorado Creek drainages. Groundwater is interpreted to discharge within the creek beds based on the observed shallow depths to water in these areas (WMCI, 2000).

Hydraulic gradients across the site vary from approximately 0.04 ft/ft near Louis Creek to 0.2 ft/ft near the divide. The relatively high hydraulic gradients in the divide area are representative of a low permeability fractured-rock flow system. In the area of the Hindenburg Pit, groundwater flows northward at an average gradient of approximately 0.10 ft/ft. Under the proposed East Pit, groundwater flows to the northeast at an average gradient of approximately 0.13 ft/ft (WMCI, 2000).

3.6.3 GROUNDWATER SYSTEM PHYSICAL CHARACTERISTICS

Groundwater at the True North site generally flows within fractured bedrock in areas of higher elevations into shallow alluvial material associated with creeks and streams. Preliminary estimates of hydraulic conductivity for the system were developed based on slug tests performed in two of the monitoring wells (WMCI, 2000). The slug tests were analyzed using the method of Bower and Rice (Kruseman and DeRidder, 1990) for unconfined wells. A summary of hydraulic conductivity estimates from the two slug tests is presented in Table 3.6-1.

Table 3.6-1
Summary of hydraulic conductivity estimates

Monitoring well	Estimated hydraulic conductivity (ft/min)	Estimated hydraulic conductivity (ft/day)	Estimated hydraulic conductivity (cm/sec)
MW-02	1.7×10^{-4}	0.25	8.8×10^{-5}
MW-07	1.1×10^{-4}	0.16	5.8×10^{-5}
Geometric mean	1.4×10^{-4}	0.20	7.1×10^{-5}

The hydraulic conductivity estimates from the two tests were similar, with a geometric mean estimate of 0.20 ft/day (7.1×10^{-5} cm/sec). The geometric mean is considered the best estimate of larger-scale hydraulic conductivity because it is assumed to vary over a log-normal distribution. The hydraulic conductivity estimates from the tests are in the range expected for fractured bedrock (WMCI, 2000).

The storage properties of the groundwater system can not be estimated directly from slug test results. However, based on work at similar sites and estimates provided in the literature (Dominico and Schwartz, 1990), it is estimated that the drainable porosity of the fractured rock ranges from less than 0.01 to 0.05. The specific yield of alluvial material near the creeks likely ranges from 0.10 to 0.30 (WMCI, 2000).

3.6.4 CONCEPTUAL MODEL OF GROUNDWATER FLOW IN THE TRUE NORTH AREA

Recharge -- Recharge to site groundwater likely occurs primarily within areas where permafrost is absent. These areas are likely associated with the broadleaf upland vegetation. At the site, these areas occur primarily along the ridge top and on south facing slopes. Recharge through the upland zone is supported by the relatively large seasonal water level fluctuations observed in TN-281. The majority of recharge likely occurs during late spring and early summer, when snowmelt is occurring, and to a lesser degree during late summer rainfall. Little to no recharge is thought to occur through the permafrost (WMCI, 2000).

Discharge -- Groundwater flows from higher elevations along the divide to lower elevations along the nearby creeks (Murry Creek, Spruce Creek, and Louis Creek). While some stretches along the creeks are underlain by permafrost, there are likely zones were permafrost is absent or taliks occur. Groundwater discharges within these zones, providing base flow to the creeks. This is supported by late summer stream flow measurements within the creeks (WMCI, 2000).

System through-flow rates -- Because of the uncertainties in physical characteristics of the flow system, a range of reasonable flow rates was estimated for the system. The total amount of groundwater flowing through the area beneath the pits was estimated based on Darcy's Law, as follows:

$Q = K \times I \times A$

Where:

Q	=	total flow rate (ft^3/day)
K	=	hydraulic conductivity (ranging from 0.028 to 0.28 ft/day)
I	=	hydraulic gradient (ranging from 0.05 to 0.20 ft/ft)
A	=	through-flow area (assuming 3,500 ft by 500 ft for both pits)

Based on the range of values provided above, groundwater flow beneath the site could range from 2,500 ft^3/day (approximately 15 gpm) to 100,000 ft^3/day (approximately 500 gpm). The estimated range of 15 to 500 gpm encompasses the flow rates observed from discrete fracture zones during exploration drilling (0 to 120 gpm) (WMCI, 2000).

Summary of groundwater flow conditions -- The conceptual model of groundwater flow at the True North site can be summarized as follows (WMCI, 2000):

Highly localized and areally limited shallow groundwater exists above the permafrost, resulting in minor near surface flows and seeps.

The main groundwater flow system occurs where permafrost is absent and below the permafrost.

Recharge to the groundwater flow system occurs primarily along the ridge top and south facing slopes where permafrost is absent.

Groundwater flows off of the divide between the Dome Creek and Little Eldorado Creek drainages, toward the north, northeast, and northwest.

Hydraulic gradients in the site area range from 0.05 ft/ft in creek bed areas to 0.20 near the ridge top.

The hydraulic conductivity of the system ranges from 0.16 ft/day to 0.25 ft/day, with a geometric mean of 0.20 ft/day.

Groundwater through-flow rates may range from 15 to 500 gpm, representative of a relatively low flow system.

Groundwater from the site area likely discharges within Murry Creek, Spruce Creek, and Louis Creek.

3.7 WATER QUALITY

The descriptions in this section of surface water and groundwater quality, and acid generating potential, have been taken from WMCI (2000).

3.7.1 SURFACE WATER QUALITY

Baseline surface water sample collection in the True North project area has been carried out since 1994 from 18 surface locations in six different drainages. These include tributaries that drain the immediate project site, streams outside of the immediate project area, and major regional streams that will receive water draining from the proposed project site. Table 3.7-1 lists the specific drainages, and the main tributaries within each drainage, that historically have been sampled. The table also includes locations being carried forward for long-term sampling. All sample locations are shown in Figure 3.7-1 (WMCI, 2000).

The headwaters for portions of the North Fork of Little Eldorado Creek, the South Fork of Little Eldorado Creek, and Dome Creek all begin in the highlands that includes the proposed open pit and other planned mine facilities. Surface water samples have been (and currently are being) collected from Upper and Lower Louis Creek, Whiskey Gulch, the North and South Forks of Spruce Creek, and Murray Creek to document the pre-mine surface water chemistry in the immediate project site. Surface water samples also have been collected at sites downstream of the immediate project area, including Little Eldorado Creek, North Fork of Little Eldorado Creek, lower Spruce Creek, South Fork of Little Eldorado Creek, Dome Creek, and Lower Dome Creek (WMCI, 2000).

Water samples collected from Marshall Gulch, Marshall Creek, and Moose Creek are within the North Fork of Little Eldorado Creek and Dome Creek drainages, respectively, but drain from highlands outside of the immediate project area. These locations provide a larger database of baseline water chemistry for areas outside of the project area. Samples collected from sites along Ruby Creek, and the North Fork of Steamboat Creek, Steamboat Creek, and Granite Creek of the Pedro Creek drainage, provide baseline water chemistry from drainage basins well outside of the project site and therefore document the range of baseline surface water chemistry (WMCI, 2000).

The North Fork of Little Eldorado Creek, South Fork of Little Eldorado Creek, and Dome Creek all discharge into the Chatanika River north and west of the project site. Surface water samples have been and are currently being collected from sites along the Chatanika River both upstream and downstream of the confluence of these streams to document the pre-mining regional surface water chemistry (WMCI, 2000).

A total of 82 surface water samples has been collected from sites in and around the True North project area. Annual water samples were collected by Newmont Mining from 1994 to 1998, with supplemental sampling at selected sites in November 1996, January 1997, and May 1997. The annual sampling program was continued in 1999 by FGMI. Table 3.7-2 summarizes the 82 sampling events and tabulates the total number of water chemical analyses available from each sampling site (WMCI, 2000).

The results of the surface water sampling program indicate there are two major water types in the True North project area, a low TDS, calcium carbonate type water and a slightly higher TDS, calcium sulfate water. The calcium sulfate type water was found in samples collected from the North Fork of Spruce Creek, the South Fork of Spruce Creek, and Whiskey Gulch. The source of the calcium and sulfate was probably the hydrothermally altered bedrock outcrops and soils of the immediate project area. The calcium sulfate type water also was found down gradient from the project area, in Lower Spruce Creek, and the South Fork of Little Eldorado Creek. This was most likely due to the lack of dilution from other influent streams in the lower reaches of Spruce Creek (WMCI, 2000).

The pH of all water samples was near neutral and the average pH for the calcium sulfate water samples ranges from 6.8 to 7.9. The neutral pH and the lack of elevated iron concentration in the water samples suggests that the source of sulfate in the calcium sulfate type waters may be from dissolution of primary hydrothermal or secondary sulfate minerals in the soils, rather than acid generation by sulfide mineral oxidation (WMCI, 2000).

Table 3.7-1
Summary of surface water sampling sites by drainage

Sampling Scale	River/Stream	Sample Site
Regional main river baseline water chemistry	Chatanika River	Chatanika River above Little Eldorado Creek (1) (2)
		Chatanika River below Dome Creek (1) (2)
		Chatanika River above Dome Creek (1)
Tributary baseline water chemistry	North Fork Little Eldorado Ck drainage	Upper Louis Creek (1)
		Lower Louis Creek (1)
		Whiskey Gulch (1)
		Marshall Gulch (1)
		Marshall Creek (2)
		Little Eldorado Creek (2)
		North Fork Little Eldorado Ck (1)
	South Fork Little Eldorado Ck drainage	South Fork Spruce Creek (1)
		North Fork Spruce Creek (1)
		Lower Spruce Creek (1)
		Spruce Creek (2)
		South Fork Little Eldorado Ck (1)
	Dome Ck drainage	Murray Creek (1)
		Moose Creek (1)
		Lower Dome Creek (1)
		Dome Creek (2)
	Ruby Ck drainage	Ruby Creek (1)
	Pedro Ck drainage	North Fork Steamboat Creek (1)
		Steamboat Creek (2)
		Granite Creek (1)

(1) Sites sampled by Newmont

(2) Sites sampled by FGMI

WATER MANAGEMENT CONSULTANTS

Figure 3.7-1 Surface water sampling locations

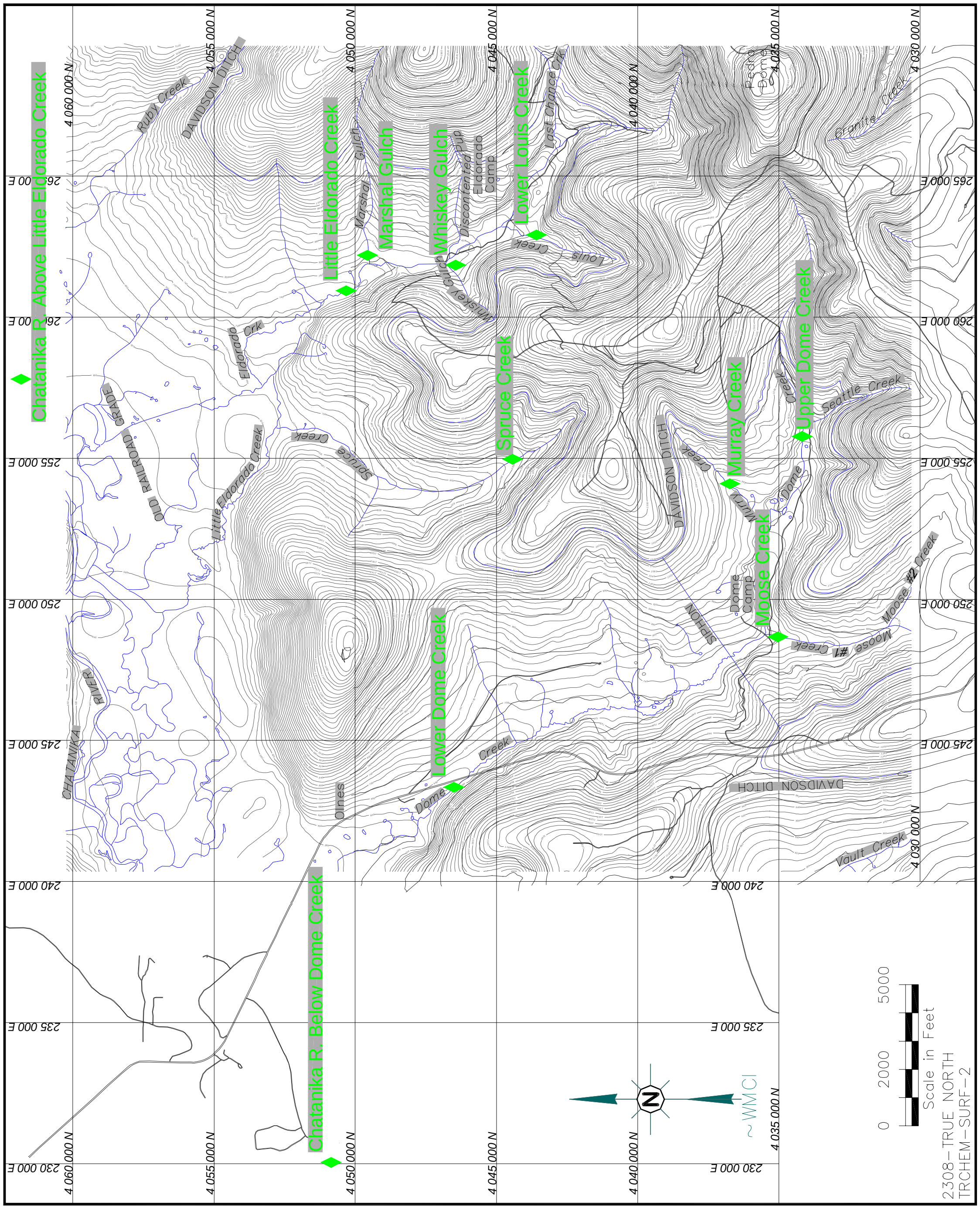


Table 3.7-2

Summary of surface water sampling events

Drainage	Location	Sampling events	No. of events
Chatanika River	Chatanika River below Dome Ck	9/20/96, 1/19/97 [2], 5/8/97 [3], 9/26/97, 9/22/99 [1]	5
	Chatanika River above Dome Ck	9/28/98	1
	Chatanika River above LEC	10/13/96, 5/9/97 [3], 10/8/97, 9/28/98, 9/23/99 [1]	5
North Fork Little Eldorado Ck	Upper Louis Creek	9/16/94, 9/27/95, 9/20/96, 5/6/97 [3]	4
	Lower Louis Creek	9/16/94, 9/26/95, 9/20/96, 5/7/97 [3], 9/26/97, 9/23/99 [1]	6
	Whiskey Gulch	9/16/94, 9/26/95, 9/24/96, 5/7/97 [3], 9/26/97, 9/29/98, 9/23/99 [1]	
	Marshall Gulch	9/24/96, 5/7/97 [3], 9/26/97, 9/29/98	4
	Marshall Creek	9/23/99 [1]	1
	Little Eldorado Creek	10/12/99 [1]	1
	North Fork Little Eldorado Ck (LEC)	10/5/95, 9/23/96, 5/7/97 [3], 10/2/97, 9/29/98	5
South Fork Little Eldorado Ck	South Fork Spruce Creek	9/16/94, 9/27/95, 9/24/96, 5/6/97 [3], 10/7/97, 9/29/98	6
	North Fork Spruce Creek	5/6/97 [3], 10/7/97, 9/29/98	3
	Lower Spruce Creek	9/23/96, 5/7/97 [3], 10/2/97, 9/29/98	4
	Spruce Creek	10/12/99 [1]	1

Table 3.7-2 (cont'd)

Summary of surface water sampling events (cont'd)

Drainage	Location	Sampling events	No. of events
	South Fork Little Eldorado Ck (LEC)	10/5/95, 9/23/96, 5/7/97 (3), 10/2/97, 9/29/98	5
Dome Creek	Murray Creek	9/16/94, 9/27/95, 9/24/96, 11/4/96(2), 5/6/97(3), 10/1/97, 9/28/98, 9/22/99(1)	8
	Moose Creek (plus DUP)	9/28/98 (2 analyses), 9/22/99 (1)	3
	Lower Dome Creek	10/5/95, 9/23/96, 5/8/97 (3), 9/26/97, 9/28/98	5
	Dome Creek	9/22/99 (1)	1
Ruby Creek	Ruby Creek	10/8/97	1
Pedro Creek	North Fork Steamboat Creek	5/9/97 (3), 10/2/97 9/28/98	3
	Steamboat Creek	9/22/99 (1)	1
	Granite Creek	9/28/98, 9/22/99 (1)	2
Total			82

(1) samples collected by FGMI

(2) analyses limited to benzene, chlorobenzene, 1,2-, 1,3-, 1,4-dichlorobenzene, ethylbenzene, toluene, xylenes, surrogate recovery

(3) analyses limited to pH, turbidity, arsenic, conductance

na not available

3.7.2 SURFACE WATER CHEMISTRY AND AQUATIC LIFE STANDARDS

With the exception of specific parameters (fecal coliform bacteria, pH, temperature, sediment, color, and residues), water quality standards for the State of Alaska use federally promulgated water quality criteria for human health and aquatic life as found at 40 C.F.R. 131.36 (18 AAC 70.020). Table 3.7-3 summarizes the results of all 82 surface water chemical analyses and includes the number of reported analyses, the number of samples with detected concentrations, the number of analyses below the machine detection limit (MDL), the minimum concentrations, the maximum concentration, and the average concentrations. The average concentration uses one half the detection limit for values reported as below the MDL (WMCI, 2000).

Table 3.7-3 includes the Alaska water quality criteria and the EPA national recommended water quality criteria (EPA, 1998). The State has adopted EPA's water quality criteria with additions of their own as the standards for water of the State. The Chatanika River is a tributary to the Tolovana River and eventually joins the Tanana River. The Chatanika River is protected for use as water supply for agricultural, aquacultural, and industrial use, for water recreation, and for growth and propagation of fish, shell fish, other aquatic life, and wildlife (designated classes (1) (A), (1) (B), and (1) (C)). The water quality criteria used for this comparison are the criterion continuous concentration (CCC, or chronic aquatic life standards) for both priority and non-priority pollutants and are reported in μg/L, except for pH (units) and temperature (°C). The chronic water quality have been used in the comparison of background to standards as they represent toxicity over the long term. The total number of exceedences for each analyte also are included in Table 3.7-3. The criteria for cadmium, copper, lead, nickel, and zinc are dependent upon the specific hardness of the water and therefore only the formulae are reported in Table 3.7-3 (WMCI, 2000).

Measured concentrations exceeding the applicable standards were noted for alkalinity, copper, iron, lead, nickel and pH. The exceedences reported for alkalinity stem from the very low criterion for alkalinity of 20 mg/l. The exceedences(s) for copper (one dissolved and five total recoverable analyses) range from less than 0.02 to 0.05 mg/l, for lead (one dissolved and one total recoverable analysis) range from 0.004 to 0.008 mg/l, and for nickel (one total recoverable analysis) WAS 0.035 mg/l. Two pH values of 6 and 6.2 are below the water quality criteria of 6.5 and 28 total iron analyses exceeded the water quality criterion of 1 mg/l (WMCI, 2000).

3.7.3 GROUNDWATER QUALITY

Baseline groundwater samples have been collected from nine wells in the True North project area since 1994. Three of these (TN-182, 281, and 672) are exploration boreholes drilled and sampled by Newmont Mining, and six (MW-2, 3, 6, 7, 8, and 9) are monitoring wells drilled by FGMI in 1999. The locations of these wells are shown on Figure 3.7-2*.*

Sixteen groundwater samples were collected from these historic and active monitoring wells. Table 3.7-4 summarizes the sampling events. Annual groundwater samples were collected by Newmont from 1994 through 1998. FGMI continued the sampling program in 2000 using the newly installed monitoring wells.

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites

Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Alkalinity as $CaCO_3$ [(2)]	mg/L	67	67	0	7.3	326	109.0	20000	60
Ammonia-N [(4)]	mg/L	62	11	51	-0.1	1.51	0.37		0
Antimony	mg/L	61	14	47	-0.003	0.018	0.003	none	0
Antimony	mg/L	66	18	48	-0.003	0.016	0.003	none	0
Arsenic	mg/L	75	55	20	-0.003	0.027	0.007	150	0
Arsenic	mg/L	80	61	19	-0.003	0.147	0.012	150	0
Barium [(2)]	mg/L	61	61	0	0.007	0.213	0.045	none	0
Barium [(2)]	mg/L	66	66	0	0.0094	0.565	0.064	none	0
Bismuth	mg/L	61	4	57	-0.02	0.1	0.04		0
Bismuth	mg/L	61	4	57	-0.02	0.2	0.05		0
Cadmium	mg/L	61	10	51	-0.0001	0.0003	0.0001	exp{(mC*ln(hardness))+bC}*CF	0
Cadmium	mg/L	66	14	52	-0.0001	0.0008	0.0001	exp{(mC*ln(hardness))+bC}	0
Calcium	mg/L	61	61	0	7.499	237	56.43		0
Calcium	mg/L	66	66	0	7.52	255	57.85		0
Calcium Hardness	mg/L	5	5	0	22.8	619	253		0
Chloride [(2)]	mg/L	66	64	2	-0.2	3.17	0.58	230000	0
Chromium	mg/L	61	0	61	-0.002	-0.002	0.001		0

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites (cont'd)

Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Chromium	mg/L	66	19	47	-0.001	0.069	0.003		0
Conductance	umhos	75	75	0	37	1900	413		0
Copper	mg/L	61	14	47	-0.003	0.019	0.005	exp{(mC*ln(hardness))+bC}*CF	1
Copper	mg/L	66	18	48	-0.005	0.052	0.008	exp{(mC*ln(hardness))+bC}	5
Cyanide, Total	mg/L	66	0	66	-0.01	-0.01	0.01		0
Cyanide, WAD	mg/L	66	0	66	-0.01	-0.01	0.01		0
Field temperature	Deg C	12	12	0	0.6	4.4	2.1	greater than 13	0
Fluoride	mg/L	66	53	13	-0.04	0.48	0.10		0
Iron (2)	mg/L	61	60	1	-0.002	1.23	0.336	none	0
Iron (2)	mg/L	66	65	1	-0.01	46.5	2.16	1000	28
Lead	mg/L	61	1	60	-0.002	0.004	0.001	exp{(mC*ln(hardness))+bC}*CF	1
Lead	mg/L	66	5	61	-0.002	0.018	0.001	exp{(mC*ln(hardness))+bC}	1
Magnesium	mg/L	61	61	0	0.91	158	23.2		0
Magnesium	mg/L	66	66	0	0.975	161	23.7		0
Manganese	mg/L	61	59	2	-0.003	1.048	0.094		0
Manganese	mg/L	66	63	3	-0.003	1.06	0.127		0
Mercury	mg/L	61	0	61	-0.0002	-0.0002	0.0001	0.77	0
Mercury	mg/L	66	4	62	-0.0002	0.0028	0.0001	0.91	0
Nickel	mg/L	49	3	46	-0.005	0.035	0.011	exp{(mC*ln(hardness))+bC}*CF	0

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites (cont'd)

Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Nickel	mg/L	54	8	46	-0.019	0.093	0.020	exp{(mC*ln(hardness))+bC}	1
Nitrate-N (2)	mg/L	66	54	12	-0.01	0.84	0.22	none	0
Nitrite-N	mg/L	61	0	61	-0.01	-0.01	0.01		0
pH	Unit	74	74	0	6	8.2	7.57	6.5-8.5	2
Potassium	mg/L	61	59	2	-0.3	6.7	1.8		0
Potassium	mg/L	66	64	2	-0.3	13.1	2.1		0
Selenium	mg/L	61	4	57	-0.002	0.009	0.002		0
Selenium	mg/L	66	10	56	-0.002	0.011	0.002		0
Silicon	mg/L	61	61	0	2.9	7.4	4.60		0
Silicon	mg/L	61	61	0	2.9	79.5	6.80		0
Silver	mg/L	61	17	44	-0.0001	0.0006	0.0011	none	0
Silver	mg/L	66	22	44	-0.0001	0.0007	0.0010		0
Sodium	mg/L	61	61	0	0.27	4.9	2.3		0
Sodium	mg/L	66	66	0	0.359	6.8	2.5		0
Sulfate	mg/L	66	64	2	-1	790	123		0
Total Dissolved Solids	mg/L	66	66	0	51	1590	310		0
Total Phosphate-P	mg/L	66	17	49	-0.01	1.43	0.07		0
Total Solids	mg/L	49	49	0	66	2800	457		0
Total Suspended Solids	mg/L	66	47	19	-1	1500	48		0
Turbidity	NTU	67	67	0	0.1	180	6.4		0

Table 3.7-3 Summary of surface water chemistry from surface water monitoring sites (cont'd)

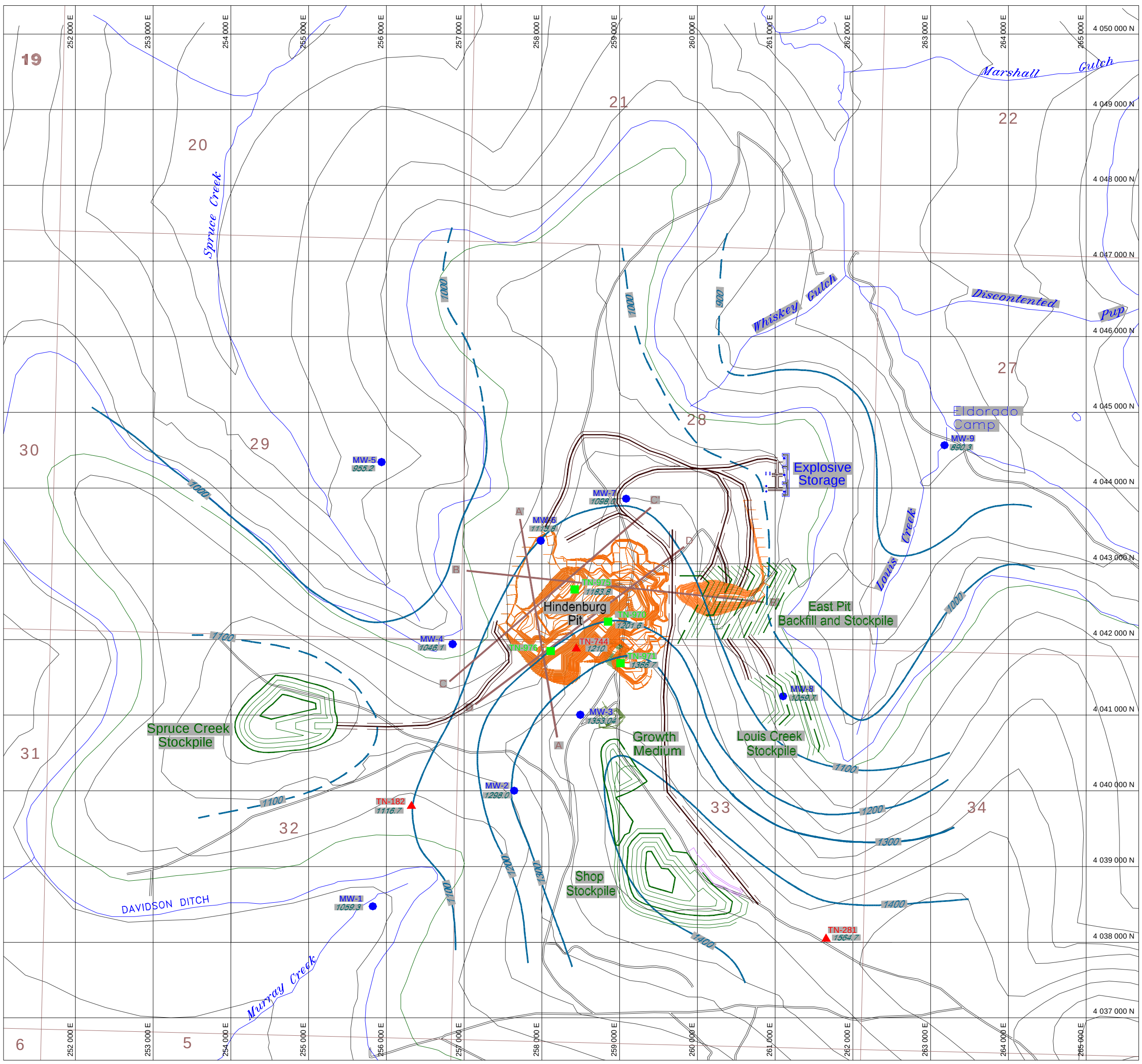
Analytes	Units	No. of analyses	No. of detects	No. of MDL's	Min	Max	Average (3)	Water Quality Criteria (1)	No. of exceedences
Zinc	mg/L	61	15	46	-0.003	0.044	0.007	exp{(mC*ln(hardness))+bC}*CF	0
Zinc	mg/L	66	12	54	-0.004	0.099	0.012	exp{(mC*ln(hardness))+bC}	0
Benzene	ug/L	14	0	14	-0.2	-0.2	0.1		0
Chlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.1		0
1,2-Dichlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.16		0
1,3-Dichlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.16		0
1,4-Dichlorobenzene	ug/L	5	0	5	-0.2	-0.2	0.16		0
Ethylbenzene	ug/L	14	0	14	-0.2	-0.2	0.1		0
Toluene	ug/L	14	2	12	-0.3	0.45	0.18		0
Xylenes	ug/L	14	0	14	-0.4	-0.4	0.2		0
Surrogate Recovery	%Recovery	14	14	0	83	99	94		0
Total Petroleum Hydrocarbons	mg/L	12	0	12	-0.5	-0.5	0.25		0
Sulfide		9	0	9	-1	-1	0.5		0

1) Water quality criteria are reported in µg/L. Values of mC and bC are constants specific for each analyte. CF is the conversion factor to calculate water quality concentrations for dissolved analyses from total analyses. Hardness is equal to [2.497*(Ca, mg/l) + 4.118*(Mg, mg/l)] expressed in mg/l as $CaCO_3$.

2) National Recommended Water Quality Criteria for Non Priority Pollutants.

3) Average concentrations use one half the detection limits for analyses reported as below the MDL.

4) No ammonia water quality standards were calculated owing to the lack of adequate surface water flow data as required for the chronic criterion (CCC) as specified in the 1999 Update of the Ambient Water Quality Criteria for Ammonia.



EXPLANATION

MW-1 1059.3	Monitoring wells installed by FGMI Water level elevation
TN-182 1116.7	Piezometers installed by Newmont Water level elevation
TN-971 1366.7	Temporary piezometers installed by FGMI Water level elevation
1000	Water level elevation contour

0 500 1000
Scale in Feet

2308-TRUE NORTH
TRUEBASE00

Monitoring Well and Piezometer Locations

CLIENT: Kinross		SCALE: 1"=500'	
JOB: 2308–True North	WATER MANAGEMENT CONSULTANTS	DRAWN: JB	CHECKED: UW
DRAWING: Figure 3.7-2		DATE: September 2000	

Table 3.7-4
Summary of groundwater sampling events

Location	Completion interval	Sampling events	Number of events
TN-182	183.7-223.7	11/9/94, 10/20/95, 9/12/96, 12/23/97, 9/29/98	5
TN-281	185.7-215.7	11/9/94, 10/23/95, 9/12/96,12/22/97	4
TN-672	na	1/22/98	1
TMW-2	250.2-270.2 290.2-330.2	2/2/00 (1)	1
TMW-3	295.7-315.6 335.5-355.4	2/2/00 (1)	1
TMW-6	251-271 291-311 331-351	2/2/00 (1)	1
TMW-7	423.1-463.1	2/2/00 (1)	1
TMW-8	226.5-246.5 266.4-306.2	2/2/00 (1)	1
TMW-9	37.9-57.8	2/2/00 (1)	1
Total			16

(1) Samples collected by FGMI

As with the surface water chemistry, two types of groundwater are present in the True North project area. Water samples from MW-6, MW-7, and TN-182 were calcium sulfate type water. The remaining water samples were calcium carbonate type groundwater. Figure 3.7-3 is a trilinear diagram showing the major element chemistry of the water samples from the monitoring wells and piezometers. The data used to develop Figure 3.7-3 includes the average groundwater chemistry for samples collected from monitoring wells TN-182 and TN-281. Figure 3.7-4 shows the sulfate concentrations in the groundwater samples from the project area. Table 3.7-5 summarizes the results of the average analyses for TN-182 and TN-281 as well as the single analyses for all other samples.

Calcium sulfate type groundwater samples were obtained from monitoring wells located along the trend of the mineralization in areas of proposed mining. The three analyses reported in Table 3.7-5 (wells TN-182, MW-6 and MW-7) record elevated concentrations of calcium, magnesium, manganese (MW-6 and MW-7), potassium, sodium (MW-6 and MW-7), sulfate, TDS, and TSS compared with calcium carbonate type groundwater samples. Total iron concentrations were high in MW-6 and MW-7, and the three Newmont samples (TN-182, TN-281, and TN-672). Chloride was exceptionally high in the single sample from MW-7.

Groundwater chemistry and groundwater quality standards

Groundwater within the State of Alaska is protected for use class as Class (1)(A) (fresh water, water supply). As such, water quality standards are defined at 40 CFR 131.36 for human health criteria for priority and non-priority pollutants and, by reference, 40 CFR 141 for safe drinking water standards. Table 3.7-6 summarizes the results of all of the surface water chemical analyses and includes the number of reported analyses, the number of samples with detected concentrations, the number of analyses below the MDL, the minimum concentrations, the maximum concentrations, and the average concentrations. The average concentration uses one half the detection limit for values reported as below the MDL.

Table 3.7-6 also includes the EPA drinking water standards (EPA, 1998) and the EPA human health criteria for priority and non priority pollutants. The minimum concentration for either the drinking water quality standards or the human health criteria was used to estimate the number of exceedences, which also are shown in Table 3.7-6.

One or more samples exceed the minimum water quality standard for antimony, arsenic, iron, manganese, sulfate, and TDS. All five of the analyses recording antimony concentrations above 0.006 mg/l occurred within historic samples (TN-182 with four exceedences and TN-672 with one exceedence). The elevated antimony concentrations do not appear to be spatially associated with the zone of elevated sulfate concentrations. Concentrations of arsenic exceed the human health standard (0.018 µg/l or 0.000018 mg/l) for all of the samples analyzed including those reported as below the MDL, because the standard is less than the minimum MDL. All of the samples from TN-182, TN 672, and MW-3 exceed the MCL (0.05 mg/l), but again these samples are not restricted to the zone of higher sulfate concentrations. Three samples exceed the secondary standard for iron, including single samples from TN-672, MW-3, and MW-9. All of the wells recorded at least one sample with TDS above the human health criteria of 250 mg/l.

Eleven samples recorded manganese concentrations that exceed the human health criteria of 0.05 mg/l, including four samples from TN-182, two samples from TN-281, and single samples from TN-672, MW-3, MW-6, MW-7, and MW-9. Since the maximum manganese concentrations occur in samples from MW-6 and MW-7 (1.79 and 1.93 mg/l respectively), the elevated manganese concentrations in the outlying hole may reflect the presence of a peripheral mineralized halo around the ore-body. All seven elevated sulfate concentrations (above 250 mg/l) were from groundwater samples collected from TN-182, MW-6, and MW-7, the calcium sulfate type water samples.

Figure 3.7-3 Trilinear plot based on groundwater samples

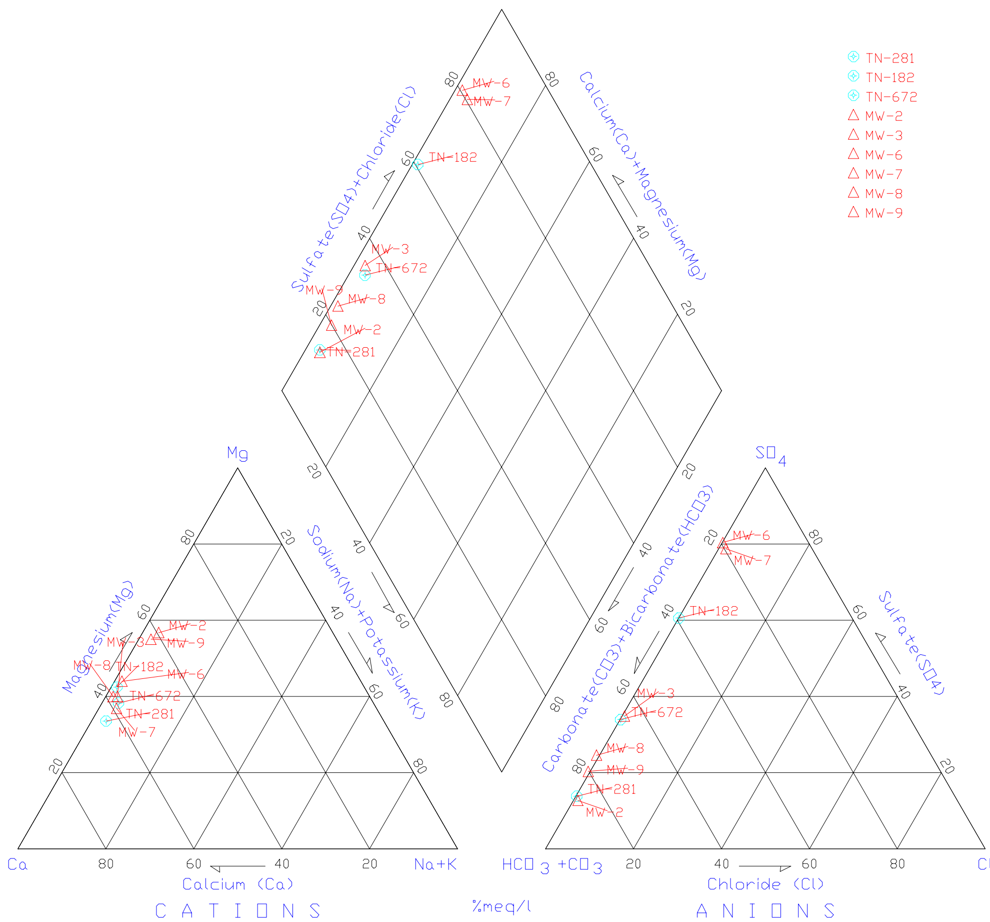


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Figure 3.7-4 Sulfate concentrations from baseline groundwater samples

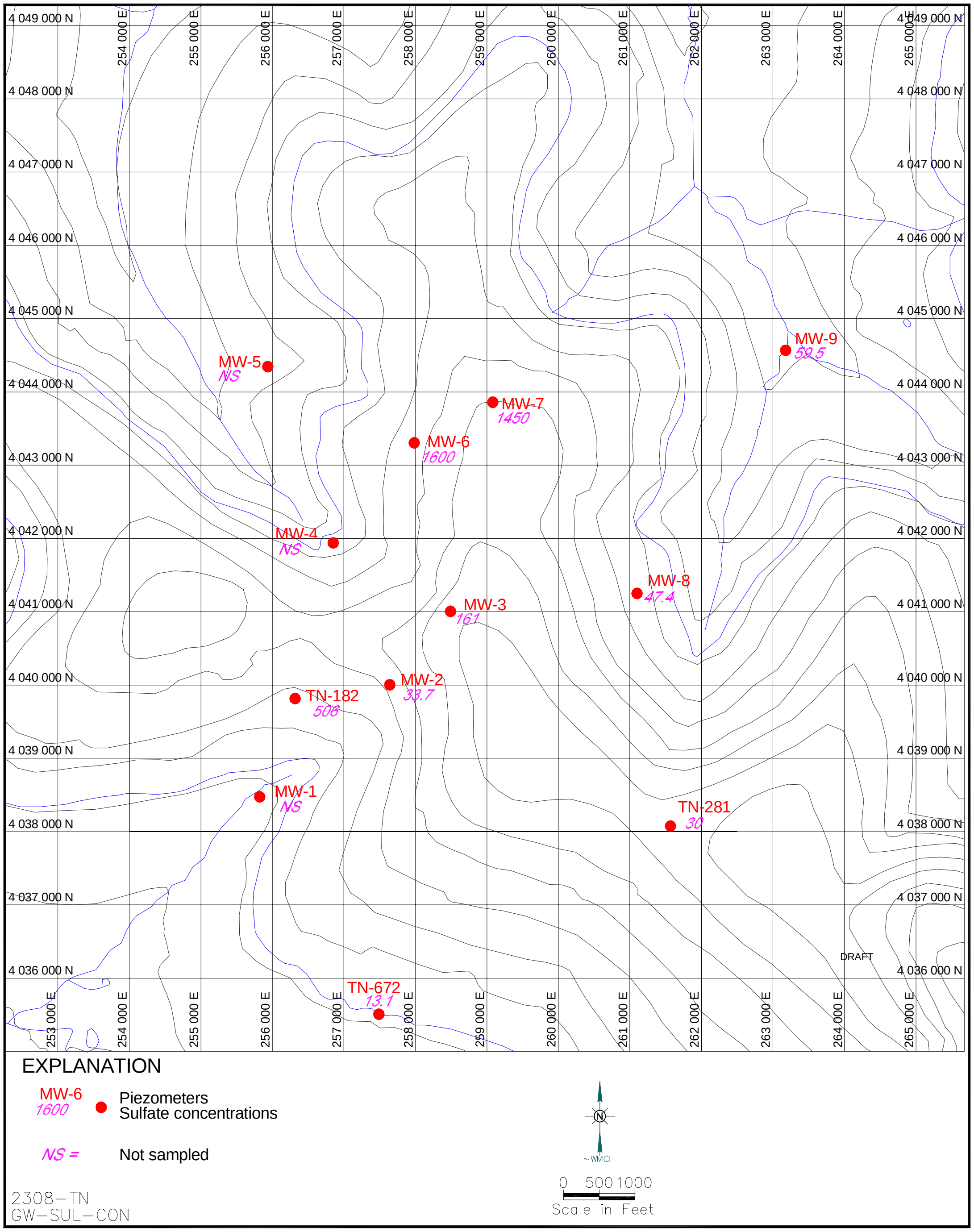


Table 3.7-5 Average groundwater chemistry for nine wells

Well		TN-281	TN-182	TN-672	MW-2	MW-3	MW-6	MW-7	MW-8	MW-9
Number of samples		**4**	**5**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Alkalinity as CaCO5	mg/L	198	343	265	238	311	405	376	153	244
Ammonia-N	mg/L	0.50	0.46	1	-0.05	0.14	0.09	-0.05	-0.05	-0.05
Antimony	mg/L	0.004	0.008	0.031	0.0017	0.0038	-0.0013	0.0028	-0.0013	0.0013
Antimony	mg/L	0.092	0.044	0.033	0.0028	0.0053	-0.0013	0.0022	-0.0013	0.0037
Arsenic	mg/L	0.029	0.149	0.415	0.008	0.43	-0.005	0.008	0.015	0.041
Arsenic	mg/L	0.438	0.470	0.533	0.015	0.414	0.052	0.015	0.015	0.046
Barium	mg/L	0.022	0.014	0.119	0.019	0.012	0.013	0.013	-0.005	0.025
Barium	mg/L	0.410	0.110	0.158	0.022	0.013	0.033	0.016	-0.005	0.029
Bismuth	mg/L	0.05	0.09	-0.1	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Bismuth	mg/L	0.14	0.09	-0.1	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Cadmium	mg/L	0.0001	0.0001	-0.0001	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005
Cadmium	mg/L	0.0002	0.0002	0.0002	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005
Calcium	mg/L	55	201	87	43.4	109	463	474	46	51.2
Calcium	mg/L	81	211	95.2	37.6	100	452	476	39.7	51.2
Calcium Hardness	mg/L	NS	NS	NS	263	0	2090	1920	194	294
Chloride	mg/L	0.3	0.3	0.3	1.9	1.8	1.5	22.3	-1	-1
Chromium	mg/L	0.001	0.001	-0.002	-0.005	-0.005	0.009	-0.005	-0.005	-0.005
Chromium	mg/L	0.041	0.029	0.012	-0.005	-0.005	0.02	0.014	-0.005	-0.005
Conductance	umhos	430	1367	870	482	828	2880	2810	373	533
Copper	mg/L	0.006	0.004	-0.005	-0.01	-0.01	-0.01	-0.01	0.02	-0.01
Copper	mg/L	0.089	0.027	-0.006	-0.01	0.01	0.02	-0.01	-0.01	-0.01
Cyanate	mg/L	0.005	0.005	NS	NS	NS	NS	NS	NS	NS
Cyanide, Total	mg/L	0.01	0.01	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cyanide, WAD	mg/L	0.01	0.01	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Field temperature	Deg C	NS	NS	NS	-1	0	1	-2	0	-1
Fluoride	mg/L	0.15	0.40	0.12	1.3	1.3	0.14	-0.05	0.13	-0.05
Hydrogen Sulfide	mg/L	NS	NS	NS	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
Iron	mg/L	0.04	0.02	1.51	-0.03	0.83	-0.03	0.3	-0.03	0.85
Iron	mg/L	43.4	10.8	3	0.003	0.95	3.08	2.02	0.04	3.26
Lead	mg/L	0.002	0.001	-0.002	0.002	-0.002	-0.002	-0.002	-0.002	-0.002
Lead	mg/L	0.086	0.016	-0.002	0.003	-0.002	0.003	-0.002	-0.002	-0.002
Magnesium	mg/L	17.7	91.8	34.8	37.7	46.2	227	179	19.1	40.4
Magnesium	mg/L	28.8	95.0	37.1	38.8	45.7	229	182	18.6	40
Manganese	mg/L	0.103	0.094	0.312	0.034	0.712	1.79	1.93	0.029	0.159
Manganese	mg/L	0.920	0.209	0.288	0.036	0.719	1.9	1.85	0.023	NS

NS = Not sampled

Table 3.7-5 Average groundwater chemistry for nine wells (continued)

Well		TN-281	TN-182	TN-672	MW-2	MW-3	MW-6	MW-7	MW-8	MW-9
Number of samples		4	5	1	1	1	1	1	1	1
Mercury	mg/L	0.0001	0.0001	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
Mercury	mg/L	0.0001	0.0001	0.0003	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
Nickel	mg/L	0.013	0.010	0.013	NS	NS	NS	NS	NS	NS
Nickel	mg/L	0.018	0.038	0.013	NS	NS	NS	NS	NS	NS
Nitrate-N	mg/L	0.07	0.03	-0.03	0.07	-0.01	0.03	-0.01	0.33	0.08
Nitrite-N	mg/L	0.02	0.03	-0.03	0.02	-0.01	-0.01	-0.01	-0.01	-0.01
pH	Unit	7.5	7.3	7.4	7.7	7.3	7.3	7.2	7.4	7.7
Potassium	mg/L	1.9	6.2	4	2.9	5.1	16.2	16.8	-1	1.9
Potassium	mg/L	14.3	8.6	4.85	2.7	4.9	17.7	17.1	-1	1.8
Selenium	mg/L	0.002	0.005	-0.003	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
Selenium	mg/L	0.003	0.008	-0.003	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005
Silicon	mg/L	3.1	4.4	6.8	2.5	5.3	5.5	7.2	3	4.5
Silicon	mg/L	198.1	21.3	10.2	2.4	5.2	9	8.4	3.1	5.2
Silver	mg/L	0.0001	0.0002	0.0001	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Silver	mg/L	0.0004	0.0002	0.0001	-0.01	0.01	-0.01	-0.01	-0.01	-0.01
Sodium	mg/L	2.18	1.61	4.12	2.9	2.6	6.8	26.7	2.1	2.7
Sodium	mg/L	3.25	1.82	4.32	2.6	2.2	7.4	23.1	2.3	2.5
Sulfate	mg/L	30	506	131	33.7	161	1600	1450	47.4	59.5
Total Dissolved Solids	mg/L	251	1088	449	330	630	2930	2770	300	390
Total Phosphate-P	mg/L	0.19	0.43	0.37	-0.05	-0.05	0.09	-0.05	-0.05	-0.05
Total Solids	mg/L	1137	1325	500	NS	NS	NS	NS	NS	NS
Total Suspended Solids	mg/L	1020	224	34	-5	-5	112	61	-5	31
Turbidity	NTU	333	84	12	NS	NS	NS	NS	NS	NS
Zinc	mg/L	0.033	0.007	-0.008	-0.01	0.02	0.06	0.04	-0.01	-0.01
Zinc	mg/L	0.082	0.044	0.011	-0.01	0.02	0.08	0.04	-0.01	-0.01
Benzene	ug/L	0.1	0.1	NS	NS	NS	NS	NS	NS	NS
Chlorobenzene	ug/L	0.1	0.1	NS	NS	NS	NS	NS	NS	NS
1,2-Dichlorobenzene	ug/L	0.1	0.1	NS	NS	NS	NS	NS	NS	NS
1,3-Dichlorobenzene	ug/L	0.1	0.1	NS	NS	NS	NS	NS	NS	NS
1,4-Dichlorobenzene	ug/L	0.1	0.1	NS	NS	NS	NS	NS	NS	NS
Ethylbenzene	ug/L	0.1	0.1	NS	NS	NS	NS	NS	NS	NS
Toluene	ug/L	0.15	0.295	NS	NS	NS	NS	NS	NS	NS
Xylenes	ug/L	0.2	0.425	NS	NS	NS	NS	NS	NS	NS
Surrogate Recovery	%Recover	98	102	NS	NS	NS	NS	NS	NS	NS
Total Petroleum	mg/L	0.2	0.2	NS	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5

NS = Not sampled

3.7.4 ACID GENERATING POTENTIAL

The potential of material to generate acid is important in terms of the proposed rock piles, and to assess potential chemistry of waters recharging the groundwater after contact with the walls of the open pits.

A total of 274 samples were collected over consecutive ten-foot depth intervals from twelve exploration drill holes and analyzed for total sulfur and acid neutralizing potential or ANP (WMCI, 2000). From these data, the acid generating potential, or AGP (total sulfur concentration in weight percent times 31.25), and net neutralizing potential, or NNP (acid neutralizing potential minus the acid generating potential) were calculated. The total sulfur content, ANP, and NNP, are plotted versus depth in Figures 3.7-5, 3.7-6 and 3.7-7. The results of the acid/base accounting analyses are summarized in Table 3.7-7 over depth intervals of 0 – 100 ft, 100 – 200 ft, 200 – 300 ft, 300 – 400 ft and 400 - 495 ft.

Total sulfur analyses show that the bedrock profile across the project site is stratified with low total sulfur concentrations in the upper 200 ft, with increasing sulfur concentrations with depth (Fig. 3.7-8). Sulfur concentrations reported in Table 3.7-7 show that roughly half of the analyses in the upper 200 feet of the drill holes were below the machine detection limit (MDL) of 0.01 weight percent. The proportions of samples with total sulfur concentrations below the MDL decreases with depth. The total sulfur concentrations in the upper 200 feet ranged from below the MDL to 0.051 weight percent and increase with depth from below the MDL to maximums of 0.65, 3.23, and 4.34 weight percent, respectively, for the intervals of 200 to 300 ft, 300 to 400 ft and 400 to 495 ft. The average total sulfur concentration for the upper 200 feet was less than 0.1 weight percent. The average total sulfur concentrations for the deeper intervals 200 to 300 ft, 300 to 400 ft and 400 to 495 ft, were 0.2, 0.7, and 2.5 weight percent, respectively. Assuming the total sulfur concentration of the bedrock was fairly uniform, the sulfur profile suggests that the bedrock is strongly weathered and oxidized at least to a depth of approximately 200 ft.

The acid neutralizing potential also shows a change in character below roughly 200 ft depth (Fig. 3.7-6). Below 300 ft depth, the ANP ranges from 170 to 240 tons $CaCO_3$/Kton rock, and averages 220 tons $CaCO_3$/Kton rock. Between 200 and 300 ft, the range in ANP varies between just below 40 to 240 tons $CaCO_3$/Kton rock, and averages 175 tons $CaCO_3$/Kton rock. Above 200 ft depth, the ANP has a much larger range, from roughly 2 tons $CaCO_3$/Kton rock to over 500 tons $CaCO_3$/Kton rock, and averages approximately 150 tons $CaCO_3$/Kton rock. The shallow analyses were distributed in roughly three populations. A group of analyses with values:

- Near 240 tons $CaCO_3$/Kton rock.
- Above roughly 400 tons $CaCO_3$/Kton rock.
- Gradational between near zero and 240 tons $CaCO_3$/Kton rock.

Assuming the stratigraphic section is roughly uniform vertically through the deposit, and the pre-weathered bedrock ANP is near 240 tons $CaCO_3$/Kton rock, the first group of analyses may represent weakly to unweathered relict bedrock with ANP equivalent to the deeper bedrock. The high ANP samples may represent a second bedrock type with higher carbonate concentration or more abundant carbonate veining. The third group of analyses may represent the weathered equivalents of either group one or two that have undergone acid leaching following weathering and oxidation of the primary, hydrothermal sulfide mineralization.

Owing to the relatively low total sulfur content of the samples, the distribution of NNP values mimics the pattern of ANP with depth (Fig. 3.7-7). Above 200 ft depth, the NNP values vary widely from less then 1 ton $CaCO_3$/Kton rock to over 530 tons $CaCO_3$/Kton rock, with three poorly defined groups: over 500 tons $CaCO_3$/Kton rock, roughly 200 tons $CaCO_3$/Kton rock, and less then 50 tons $CaCO_3$/Kton rock. Below 200 ft, the NNP varies between 30 tons $CaCO_3$/Kton rock and 250 tons $CaCO_3$/Kton rock, and averages between 150 and 200 tons $CaCO_3$/Kton rock.

The NNP is a measure of the acid generating potential of the rock mass as a whole. None of the samples were acid generating based on the standard criterion for the prediction of acid generation of NNP less than -20 tons $CaCO_3$/Kton rock. Samples with NNP values greater than 20 tons are considered nonacid generating. Roughly 70 percent of the samples in the top 200 ft of the drill holes were nonacid generating (64 percent in the upper 100 ft and 82 percent between 100 and 200 ft). Samples below 200 ft were all nonacid generating. The acid generating potential for the remaining samples fall within the uncertain range (between –20 and 20 tons $CaCO_3$/Kton rock).

Figure 3.7-8 is a plot of the total sulfur analyses versus NNP. The figure indicates that values with NNP less then 20 tons $CaCO_3$/Kton rock also have total sulfur concentrations that are very low. Of the 65 samples with NNP values less then 20 tons, half (32 samples) have total sulfur concentrations below the MDL (0.01 weight percent). The remaining samples are less then 0.16 weight percent. Using one half the detection limit for values reported as below the MDL, the average total sulfur concentration of the samples with NNP less then 20 tons was 0.02 weight percent. Based on this analysis, the rock material that would be generated from the pit area is not considered to be acid generating.

The results of ore and development rock characterizations were evaluated by a third-party consultant for the State of Alaska (SRK Consulting, Solid Waste Disposal Permit 0031-BA008-Fort Knox Mine Review of Requirements for Geochemical Characterization of True North Project Tailings, July 24, 2000). The evaluation showed minimum potential for any adverse impacts to any surface or ground waters of the state. The report characterized the deposit as having very low sulphur concentrations and elevated neutralization potential.

Table 3.7-6 Summary of groundwater chemistry from nine groundwater monitoring wells

Analytes	Units	No. of analyses	No. of detects	No. of MDLs	Min	Max	Average(1)	EPA drinking water standards	Human health standards	No. of exceedences
Alkalinity as CaCO5	mg/L	16	16	0	153	405	281	*	none (2)	0
Ammonia-N	mg/L	16	4	12	-0.05	1	0.35	*		0
Antimony	mg/L	15	12	3	-0.0013	0.031	0.006	0.006	0.014 (3)	5
Antimony	mg/L	16	14	2	-0.0013	0.221	0.040	*		0
Arsenic	mg/L	15	14	1	-0.005	0.43	0.117	0.05	0.000018	14
Arsenic	mg/L	16	16	0	0.015	1.54	0.324	*		0
Barium	mg/L	14	13	1	-0.005	0.119	0.023	2	1.0 (2)	0
Barium	mg/L	14	13	1	-0.005	0.72	0.139	*		0
Bismuth	mg/L	14	1	13	-0.02	0.2	0.04	*		0
Bismuth	mg/L	14	2	12	-0.02	0.3	0.06	*		0
Cadmium	mg/L	16	1	15	-0.0001	0.0001	0.0001	0.005	none (3)	0
Cadmium	mg/L	16	4	12	-0.0001	0.0006	0.0002	*		0
Calcium	mg/L	16	16	0	43.4	474	156	*		0
Calcium	mg/L	16	16	0	37.6	476	165	*		0
Calcium Hardness	mg/L	5	5	0	194	2090	952.2	*		0
Chloride	mg/L	16	13	3	-0.05	22.3	1.95	250 (2)	none (2)	0
Chromium	mg/L	16	3	13	-0.002	0.009	0.002	0.1		0
Chromium	mg/L	16	12	4	-0.005	0.128	0.023	*		0
Conductance	umhos	12	12	0	350	2880	1145	*		0
Copper	mg/L	16	4	12	-0.003	0.02	0.006	1.3	1.3	0
Copper	mg/L	16	9	7	-0.006	0.231	0.034	*		0
Cyanate	mg/L	2	0	2	-0.01	-0.01	0.005	*		0
Cyanide, Total	mg/L	16	0	16	-0.01	-0.01	0.01	*		0
Cyanide, WAD	mg/L	16	0	16	-0.01	-0.01	0.01	*		0
Field temperature	Deg C	6	0	0	-1	1	0.0	*		na
Fluoride	mg/L	16	14	2	-0.05	1.3	0.35	4		0
Hydrogen Sulfide	mg/L	6	0	6	-0.04	-0.04	0.02	*		0
Iron	mg/L	16	8	8	-0.01	1.51	0.24	0.3 (2)	0.3 (2)	3
Iron	mg/L	16	16	0	0.003	111	15.0	*		0
Lead	mg/L	16	2	14	-0.002	0.003	0.001	0.015	none	0

Table 3.7-6 Summary of groundwater chemistry from nine groundwater monitoring wells (cont'd)

Analytes	Units	No. of analyses	No. of detects	No. of MDLs	Min	Max	Average(1)	EPA drinking water standards	Human health standards	No. of exceedences
Lead	mg/L	16	9	7	-0.002	0.242	0.027	*		0
Magnesium	mg/L	16	16	0	13.9	227	69.6	*		0
Magnesium	mg/L	16	16	0	17.8	229	73.8	*		0
Manganese	mg/L	16	15	1	-0.012	1.93	0.366	0.05 (2)	0.05 (2)	11
Manganese	mg/L	15	15	0	0.023	2.52	0.636	*		0
Mercury	mg/L	15	0	15	-0.0002	-0.0002	0.0001	0.002	0.00005	0
Mercury	mg/L	15	1	14	-0.0002	0.0003	0.0001	*		0
Nickel	mg/L	10	2	8	-0.005	0.013	0.011	*	0.61	0
Nickel	mg/L	10	3	7	-0.019	0.137	0.028	*		0
Nitrate-N	mg/L	16	9	7	-0.01	0.33	0.06	10	10 (2)	0
Nitrite-N	mg/L	16	2	14	-0.01	0.1	0.02	1		0
pH	Unit	14	14	0	7	7.7	7.41	6.5-8.5 (2)	5 – 9 (2)	0
Potassium	mg/L	16	15	1	-1	16.8	5.38	*		0
Potassium	mg/L	16	15	1	-1	32.2	9.35	*		0
Selenium	mg/L	16	6	10	-0.002	0.009	0.003	0.05	0.17 (3)	0
Selenium	mg/L	16	5	11	-0.002	0.018	0.004	*		0
Silicon	mg/L	14	14	0	2.5	7.2	4.4	*		0
Silicon	mg/L	14	14	0	2.4	484	51.6	*		0
Silver	mg/L	16	6	10	-0.0001	0.0003	0.002	0.1 (2)	none	0
Silver	mg/L	16	9	7	-0.0001	0.01	0.002	*		0
Sodium	mg/L	16	16	0	1.3	26.7	4.04	*		0
Sodium	mg/L	16	16	0	1.61	23.1	4.16	*		0
Sulfate	mg/L	16	16	0	27.8	1600	383	250 (2)		7
Total Dissolved Solids	mg/L	16	16	0	212	2930	890	500 (2)	250 (2)	13
Total Phosphate-P	mg/L	14	7	7	-0.04	1.51	0.21	*		0
Total Solids	mg/L	8	8	0	500	2100	1151	*		0
Total Suspended Solids	mg/L	14	11	3	-5	1500	300	*	none (2)	0
Turbidity	NTU	8	8	0	0.55	600	168	*		0
Zinc	mg/L	16	9	7	-0.003	0.1	0.019	5 (2)	9.1	0

Table 3.7-6 Summary of groundwater chemistry from nine groundwater monitoring wells (cont'd)

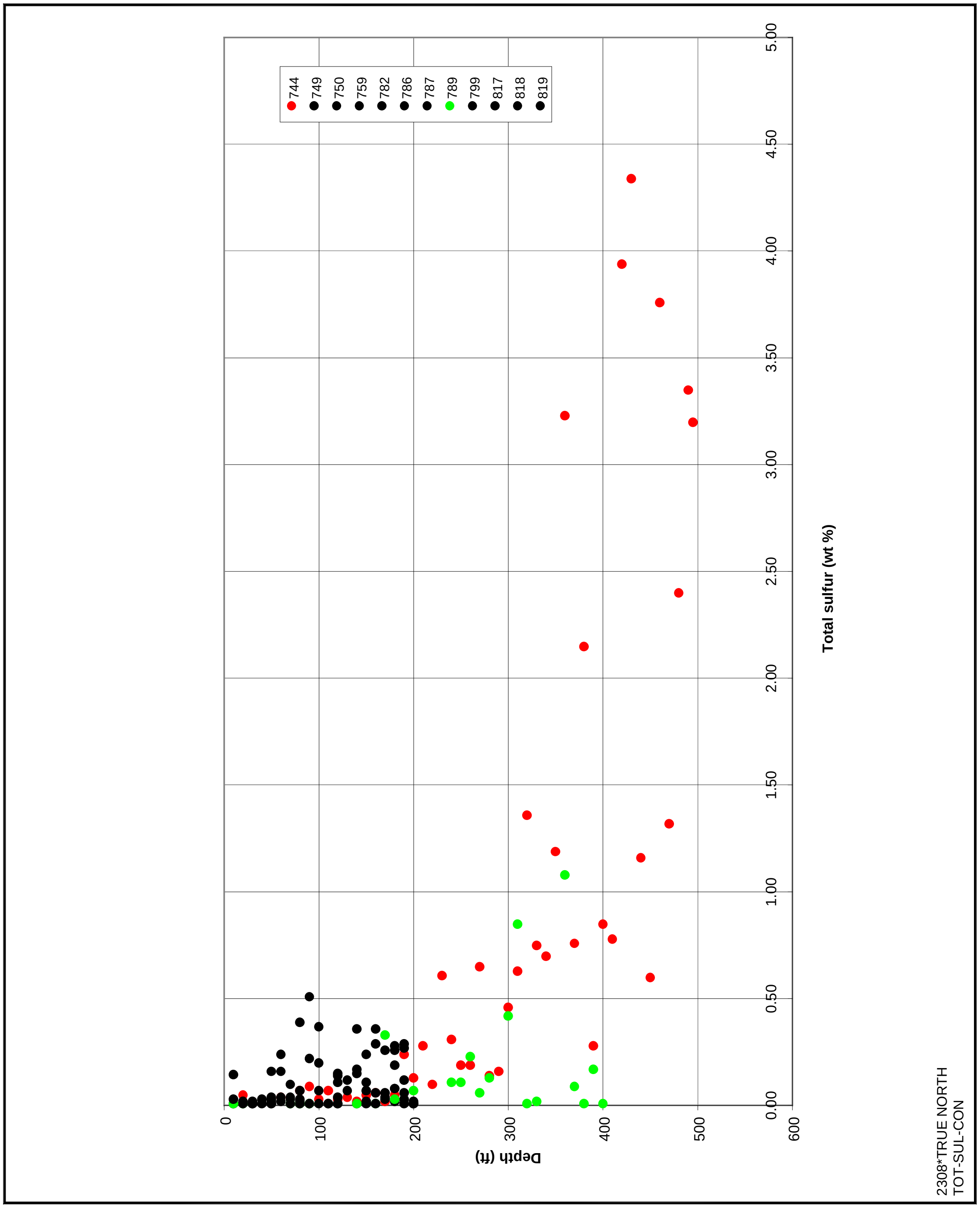
Analytes	Units	No. of analyses	No. of detects	No. of MDLs	Min	Max	Average(1)	EPA drinking water standards	Human health standards	No. of exceedences
Zinc	mg/L	16	10	6	-0.009	0.211	0.045	*		0
Benzene	ug/L	4	0	4	-0.2	-0.2	0.1	5	1.2	0
Chlorobenzene	ug/L	4	0	4	-0.2	-0.2	0.1	100	680 (3)	0
1,2-Dichlorobenzene	ug/L	4	0	4	-0.2	-0.2	0.1	*	2700 (3)	0
1,3-Dichlorobenzene	ug/L	4	0	4	-0.2	-0.2	0.1	*	400	0
1,4-Dichlorobenzene	ug/L	4	0	4	-0.2	-0.2	0.1	*	400	0
Ethylbenzene	ug/L	4	0	4	-0.2	-0.2	0.1	700	3100 (3)	0
Toluene	ug/L	4	1	3	-0.3	0.44	0.22	1000	6800 (3)	0
Xylenes	ug/L	4	1	3	-0.4	0.65	0.31	10000		0
Surrogate Recovery	%Recovery	4	4	0	95	107	100	*		0
Total Petroleum Hydrocarbons	mg/L	8	0	8	-0.4	-0.4	0.2	*		0

(1)Averages use one half the detection limit for the concentrations reported as below the machine detection limit (MDL)

(2) indicate secondary water quality standards

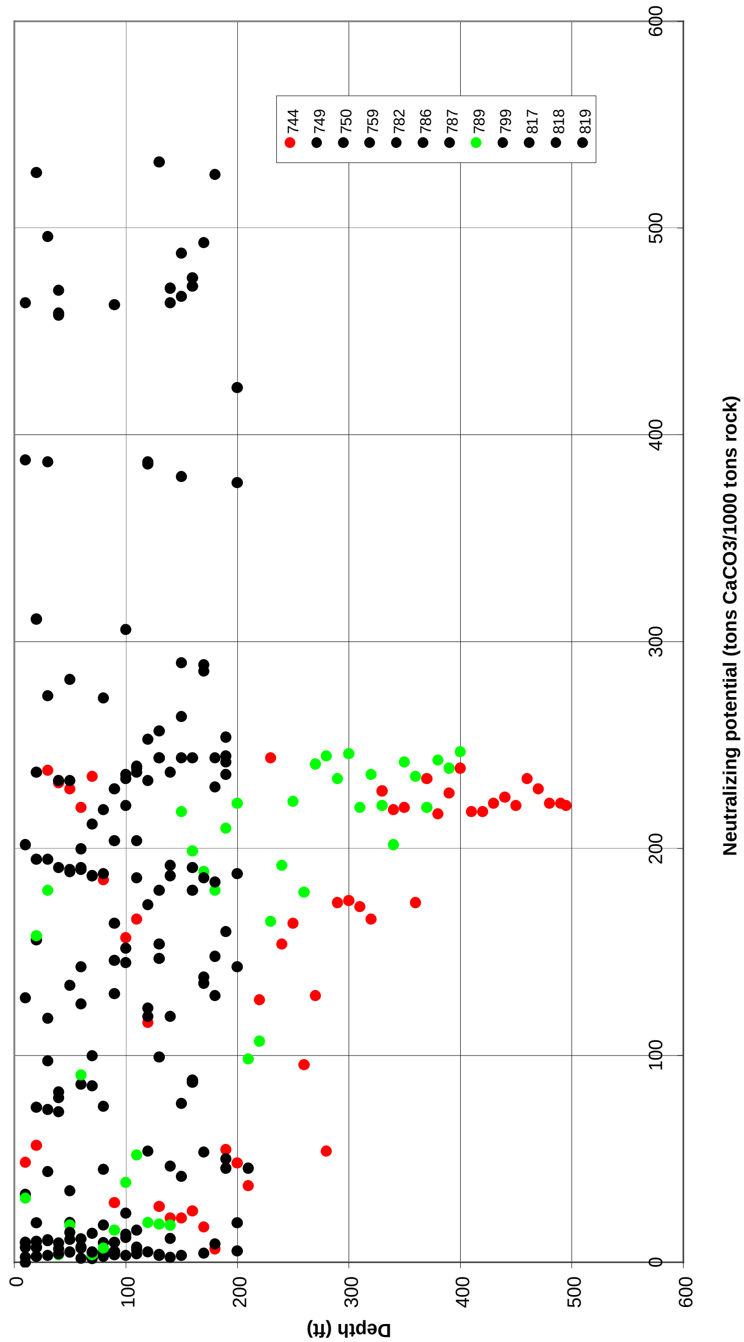
(3) Human health criteria site more stringent standards under 40 CFR 141 and Safe Drinking water Standards

Figure 3.7-5   Total sulfate content from ABA samples



WATER MANAGEMENT CONSULTANTS

Figure 3.7-6 Acid neutralizing potential from ABA samples



2308-TRUE NORTH
ACID-POT-R

WATER MANAGEMENT CONSULTANTS

Figure 3.7-6 Acid neutralizing potential from ABA samples

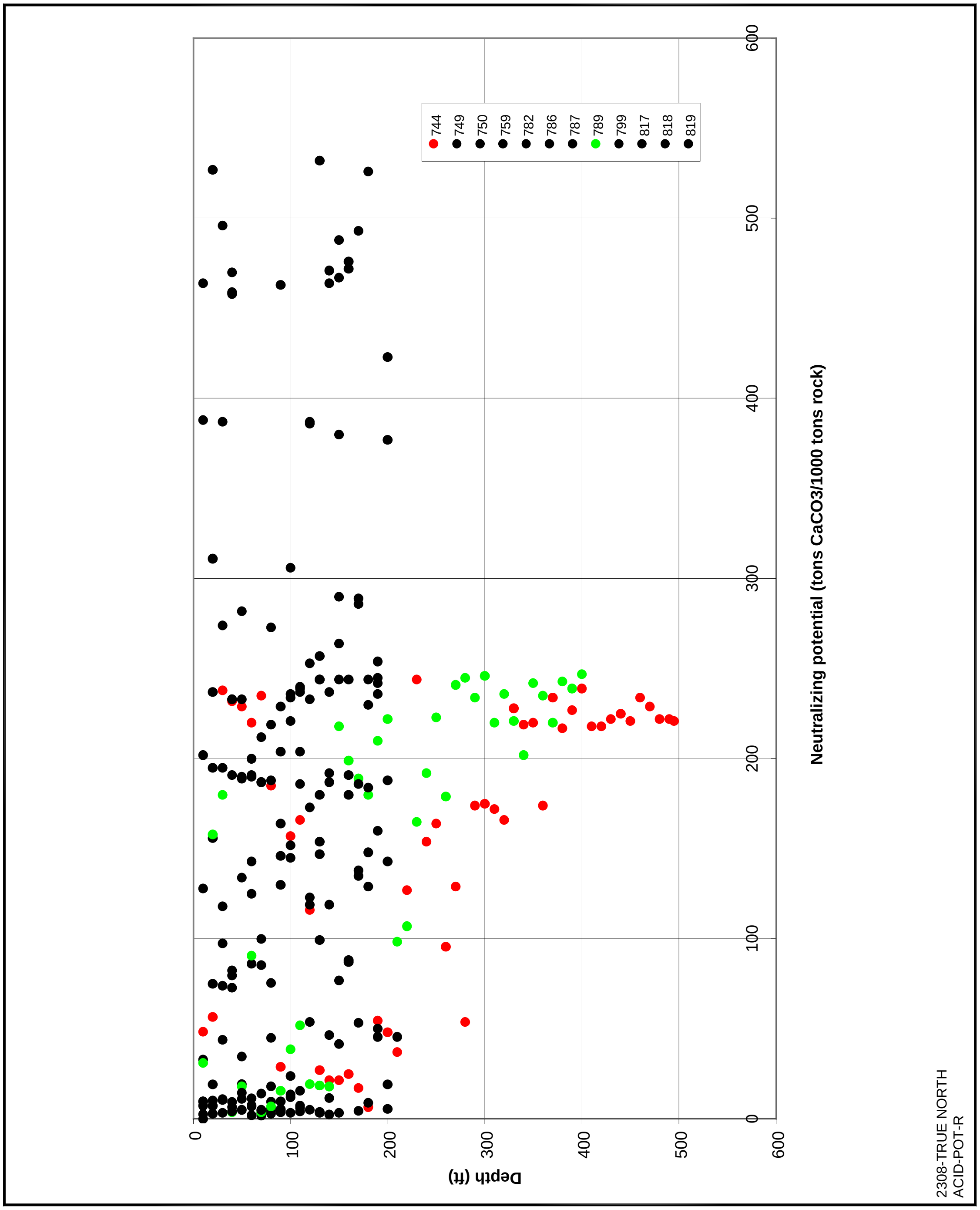
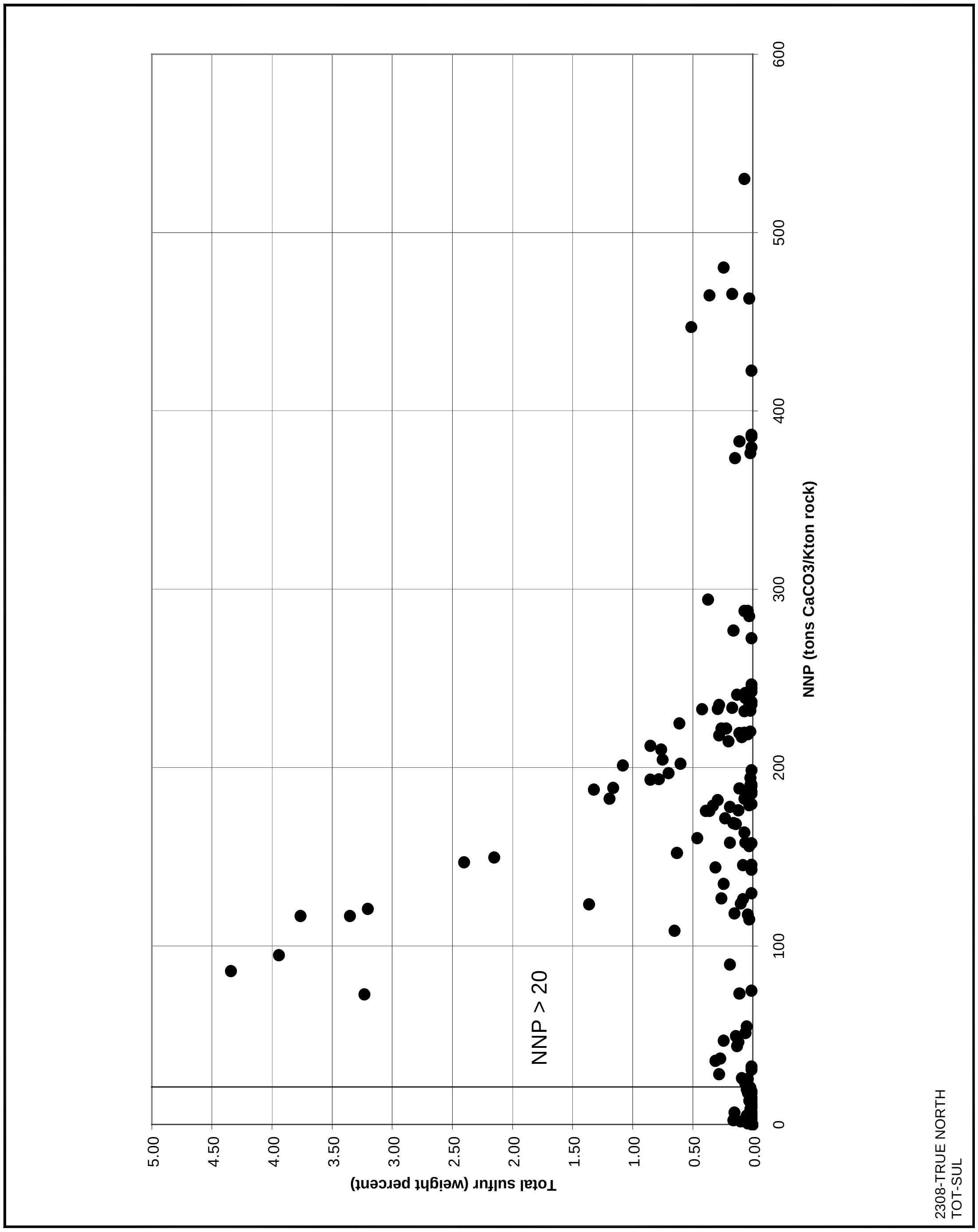


Table 3.7-7
Summary of acid/base accounting analyses from True North

	Units	0–100 ft	100-200 ft	200–300 ft	300-400 ft	400–495 ft
Total sulfur						
Number of samples		122	102	20	20	10
Number below MDL		68	42	4	2	0
Minimum	wt %	<0.01	<0.01	<0.01	<0.01	0.6
Maximum	wt %	0.51	0.36	0.65	3.23	4.34
Average	wt %	0.032	0.062	0.208	0.708	2.485
Neutralizing potential						
Number of samples		122	102	20	20	10
Number below MDL		0	0	0	0	0
Minimum	tons CaCO3/Kton rock	1.85	2.41	37.1	166	218
Maximum	tons CaCO3/Kton rock	527	532	246	243	234
Average	tons CaCO3/Kton rock	126.2	174.3	164.2	220.1	223.2
Net neutralizing potential						
Number of samples		122	102	20	20	10
Number below MDL		0	0	0	0	0
Minimum	tons CaCO3/Kton rock	0.74	2.41	28.4	73	86
Maximum	tons CaCO3/Kton rock	527	530	240.9	246.7	202.3
Average	tons CaCO3/Kton rock	125.2	172.4	157.7	198.0	145.6
Number NNP > 20		78	82	20	20	10
Percent NNP > 20		63.9	80.3	100	100	100

Figure 3.7-8 Total sulfur versus NNP from ABA samples



3.8 VEGETATION

The project area is predominantly forested, although at higher elevations shrub communities are more prevalent. Well-drained soils of the uplands and alluvial plains are covered mainly with white spruce (*Picea glauca*) and a mixture of broadleaf trees such as paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*). The climax forest on well-drained soils in the area is white spruce (America North, Inc., 1991)

The moderately well-drained and imperfectly drained soils may support forests similar to those on well-drained soils, but more commonly black spruce (*Picea mariana*) and willows (*Salix* spp.) are found. Mosses (*Sphagnum* spp.), horsetail (*Equisetum* spp.), and grasses typically cover the ground. Shrubs such as willow, however, also are prevalent (America North, Inc., 1991).

The poorly drained soils with a high permafrost table generally support communities of black spruce, willow, and alder (*Alnus* spp.). A thick moss mat, principally *Sphagnum* spp., covers the ground. Lichens such as *Cladonia* spp. and *Peltigera* spp. are common in the moss mat also. This mat supports a dense cover of shrubs, primarily bog birch (*Betula glandulosa*), spirea (*Spirea beauverdiana*), Labrador tea (*Ledum decumbens*), cranberry (*Vaccinium vitis-idaea)*, and blueberry (*Vaccinium uliginosum*). Tussocks of cottongrass (*Eriophorum* spp.) are also common, especially along the toe slopes (America North, Inc., 1991).

Poorly drained soils with a high permafrost table may be found on the northern exposures of mountain slopes, especially those areas that are concave or broken. Spindly black spruce and a thick moss mat are typical on these sites. Permafrost is discontinuous throughout the project area, and does not exist on some north-facing mountain slopes where it normally would be expected. South-facing slopes receive much more radiation from the sun, and generally support white spruce, paper birch, and quaking aspen (America North, Inc., 1991).

3.8.1 MINE AREA

Vegetation in the True North Mine area was classified by Anderson et al. (1995, 1996, 1997, 1998) from 1995 to 1998 according to an ecological land classification system developed by Jorgenson and Smith (1995) for the Fort Wainwright area near Fairbanks. This system incorporates physiographic (landscape) features with the Alaska vegetation classification developed by Viereck et al. (1992).

Table 3.8-1 and Figure 3.8-1 present the vegetation types on the approximately 17,564 acres (7,108 ha) of the True North mining claims.

The area is dominated by upland forest (58 percent), upland shrub (8 percent), lowland forest (7 percent), and lowland shrub (23 percent).

The upland forest types are dominated by open and closed needleleaf (26 percent), primarily black spruce, and open and closed broadleaf (18 percent), primarily aspen and paper birch. Mixed forests, open and closed, consisting primarily of paper birch and white spruce, cover 14 percent of the area. Tall open scrub, primarily “dwarf” spruce 5 to 10 feet (1.5 - 3 m) high, comprises 5 percent of the area.

3.8.2 ORE HAUL ROAD

Vegetation along the proposed ore haul road corridor is dominated by open black spruce forest and black spruce woodlands. Woodland areas often have an open canopy of tall deciduous shrubs (*Betula nana, B. occidentalis, Alnus crispa, and Salix sp.*). Open deciduous forest of aspen (*Populus tremuloides*) also occur in the road corridor, but are present in small isolated patches (ABR, 2000a).

Table 3.8-1.
Vegetation types and area of each type found on the True North mining claims.

Physiography[2]	Vegetation Type[1]		Area		Percent of Total
	Level 1[3]	Levels 2–3[4]	Hectares[5]	Acres	
Upland	Forest	Needleleaf-closed	634.8	1568.6	8.9
		Needleleaf-open	1189.6	2939.5	16.7
		Broadleaf-closed	1077.2	2661.8	15.2
		Broadleaf-open	166.7	411.9	2.3
		Mixed-closed	628.9	1554.0	8.8
		Mixed-open	404.3	999.0	5.7
	Scrub	Tall-closed	104.6	258.5	1.5
		Tall-open	374.6	925.6	5.3
		Low-closed	29.3	72.4	0.4
		Low-open	56.0	138.4	0.8
Lowland	Forest	Needleleaf-closed	19.9	49.2	0.3
		Needleleaf-open	474.5	1172.5	6.7
		Broadleaf-open	1.5	3.7	<0.1
		Mixed-open	6.9	17.0	0.1
	Scrub	Tall-closed	157.0	387.9	2.2
		Tall-open	665.7	1644.9	9.4
		Low-closed	694.3	1715.6	9.8
		Low-open	134.9	333.3	1.9
Riverine	Forest	Broadleaf-closed	4.2	10.4	0.1
		Broadleaf-open	8.7	21.5	0.1
		Mixed-closed	1.7	4.2	<0.1
		Mixed-open	1.7	4.2	<0.1
	Scrub	Tall-closed	72.4	178.9	1.0
		Tall-open	30.6	75.6	0.4
		Low-closed	9.9	24.5	0.1
	Barren		0.2	0.5	<0.1
Lowland/Riverine	Meadow		38.1	94.1	0.5
Pond			10.9	26.9	0.2
Pond (impoundment)			3.1	7.7	0.0
Human Disturbed			105.5	260.7	1.5
Total Area			7,108.3	17563	

1 Vegetation types follow Viereck et al. (1992) and physiography follows Jorgenson and Smith (1995).

2 Physiography refers to the topographic and hydrologic characteristics of the site (i.e., the landscape features).

3 Forests include trees >3 m (10 ft) high and a tree canopy cover >25%. Scrub includes areas with trees <3 m high ("dwarf" trees), <25% large tree cover, and shrub cover ≥30%.

4 More than 60% of canopy cover contributed by needleleaf (conifer) trees, or broadleaf (hardwood) trees. Mixed forests are those where needleleaf and broadleaf trees contribute 25–75% canopy cover. Open refers to open tree canopy (25–59% canopy cover), closed refers to closed tree canopy (60-100% canopy cover). Tall scrub is >1.5 m high, low scrub is <1.5 m high. For scrub types, open canopy is 25–75% cover and closed canopy is >75% cover.

5 Hectare; 1 ha = 2.471 acres.

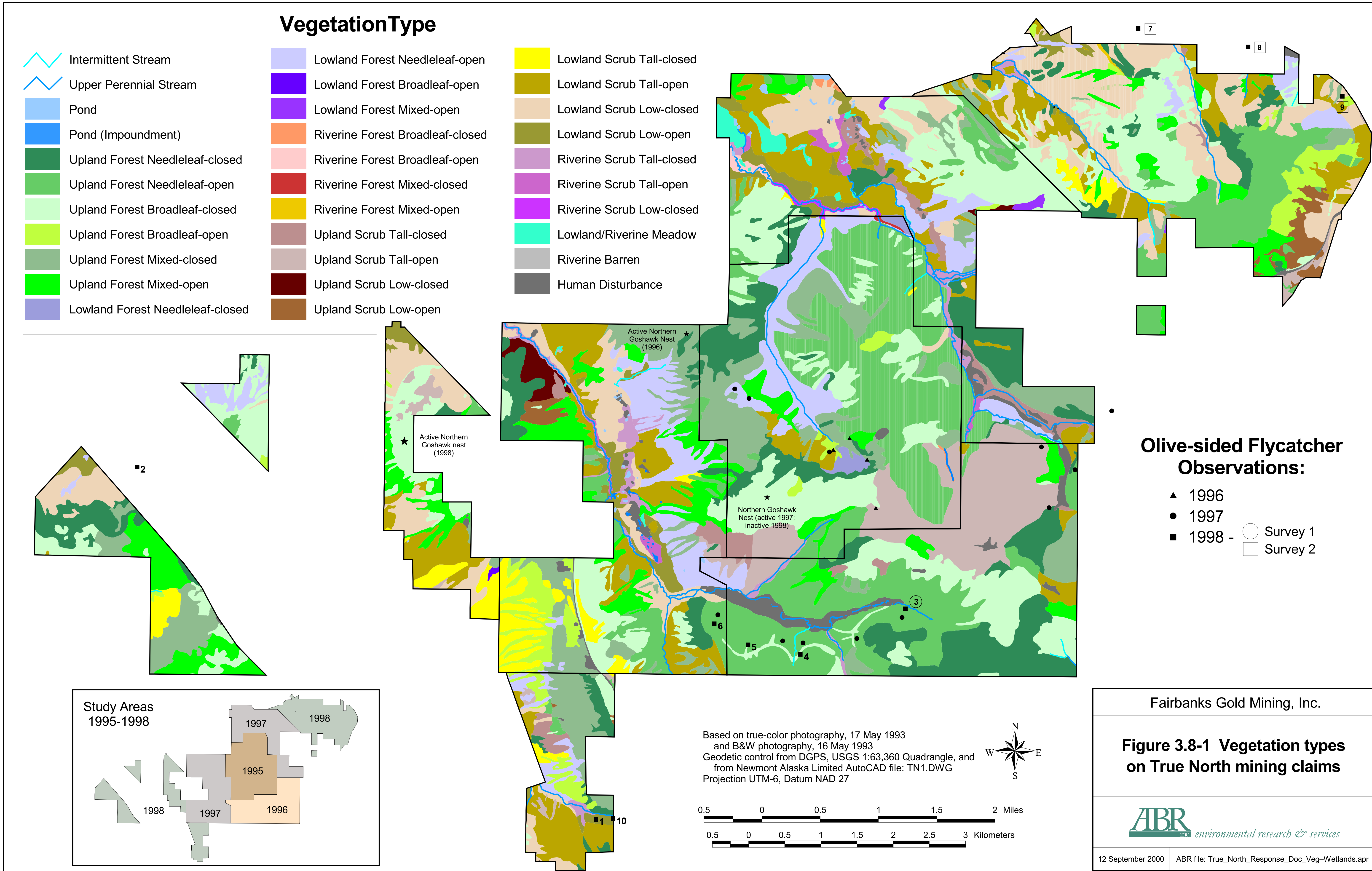


Figure 3.8-1 Vegetation types on True North mining claims

Table 3.8-2 presents a list of common and scientific names of plants present on the True North mining claims.

Table 3.8-2

Common and scientific names of plants present on the True North mining claims

Common Name[1]	Scientific Name
Paper birch	*Betula papyrifera*
White spruce	*Picea glauca*
Black spruce	*P. mariana*
Balsam poplar	*Populus balsamifera*
Quaking aspen	*P. tremuloides*
Shrubs	
American green alder	*Alnus crispa*
Thinleaf alder	*A. tenuifolia*
Dwarf birch	*Betula glandulosa*
Leatherleaf	*Chamaedaphne calyculata*
Crowberry	*Empetrum nigrum*
Narrow-leaf Labrador tea	*Ledum decumbens*
Labrador tea	*L. groenlandicum*
Bog cranberry	*Oxycoccus microcarpus*
Prickly rose	*Rosa acicularis*
Feltleaf willow	*Salix alaxensis*
Bebb willow	*S. bebbiana*
Grayleaf willow	*S. glauca*
Sandbar willow	*S. interior*
Diamondleaf willow	*S. planifolia-pulchra*
Beauverd spiraea	*Spiraea beauverdiana*
Blueberry	*Vaccinium uliginosum*
Lingonberry	*Vaccinium vitis-idaea*
Graminoids	
Bluejoint	*Calamagrostis canadensis*
Bigelow sedge	*Carex bigelowii*
Tall cottongrass	*Eriophorum angustifolium*
Tussock cottongrass	*E. vaginatum.*
Herbs	
Dwarf dogwood	*Cornus canadensis*
Club moss	*Lycopodium sp*
Meadow horsetail	*Equisetum pratense*
Woodland horsetail	*E. sylvaticum*
Tall Fireweed	*Epilobium angustifolium*
River Beauty	*E. latifolium*
Northern commandra	*Geocaulon lividum*
Grove sandwort	*Moehringia lateriflora*
Meadow bistort	*Polygonum bistorta*
Nagoon-berry	*Rubus arcticus*
Cloudberry	*Rubus chamaemorus*
No common name	*Saussuria angustifolia*

1 Taken from Viereck et al. (1992) and Welsh (1974).

3.9 Wetlands

3.9.1 Mine Area

Wetlands the True North mining claims were classified by Roth and Kidd (1996), Kidd and Rossow (1996), Kidd and Pullman (1997), and Pullman and Kidd (1998) from 1995 to 1998 according to guidelines outlined in Cowardin et al. (1979). Taxonomic nomenclature followed Hultén (1968), with the exception of willows (*Salix* spp.), which followed Viereck and Little (1972). Soils were classified using the Munsell Soil Color Chart (1990, 1992), as well as Keys to Soil Taxonomy (Soil Survey Staff, 1992) and field Manual for Describing Soils (Bates et al., 1982). Wetland determinations were made as described in the COE Wetlands Delineation Manual (USACOE, 1987).

Figure 3.9-1 and Table 3.9-1 present wetland types and National Wetland Inventory (NWI) classifications for the approximately 17,569 acres (7,110 ha) of the True North mining claims. There were 22 wetland types, plus the disturbed wetland / upland complexs. There were 42 NWI classes, plus two classes in the disturbed wetland/ upland complexs. Undisturbed wetlands covered just over half of the area surveyed (51.7 percent).

There were two dominant wetland types: the dwarf black spruce woodland / ericaceous shrub type covering 21.1 percent of the total area (41.3 percent of undisturbed wetlands) and composed of four NWI classes, and the black spruce forest / scrub shrub type covering 13.2 percent of the total area (25.8 percent of undisturbed wetlands) and composed of three NWI classes. Mixed riparian shrub / grained wetlands; shrub / sedge bog, shrub swamp, and floating mat; ponds and impoundments; and ephemeral and perennial streams also are present, and collectively represent less than 2 percent of the total area (3.8 percent of undisturbed wetlands).

Uplands (48.3 percent of the total area) primarily consist of broadleaf and needleleaf forest. Revegetated tailing piles deposited in wetland areas were often dominated by deciduous shrubs and small trees.

Many of the scrub-shrub wetlands included stunted black spruce, which were classified as shrubs because their height was less than 10 feet (3 m). Most of these dwarf trees ranged from 3 to 6 feet (1-2 m) in height. Scrub-shrub black spruce wetland types generally contained an under story of both evergreen (e.g., Labrador tea and lingo berry) and deciduous (e.g., blueberry) ericaceous shrubs. Horsetail, sedge tussocks, and *Carex* sedges also commonly were present in the understory.

3.9.2 Ore Haul Road

Most of the proposed road alignment is situated in upland areas. With the exception of one small area, all wetlands occur on north-trending slopes near Pedro Dome (Fig. 3.9-2). A small section (0.05 mi) of the road corridor consists of a mosaic of upland and wetland areas too small to delineate as separate units. A single intermittent stream crosses the proposed road corridor north of Pedro Dome (Fig. 3.9-2). The stream is small (30 cm bank to bank) and has a partially vegetated bed (ABR, 2000a).

Soils in the project area consist of silts to very gravelly silt loam over fractured bedrock. Uplands were distinguished by a lack of hydric soil indicators and ice-poor conditions in the frozen soil. On north-facing aspects, upland areas were nearly devoid of mineral soils, while wetlands in these area had relatively thick mineral soil horizons. Hydric soils in the project area consist of either histosols or mineral soils with gleyed or low-chroma colors present in the top 18 inches.

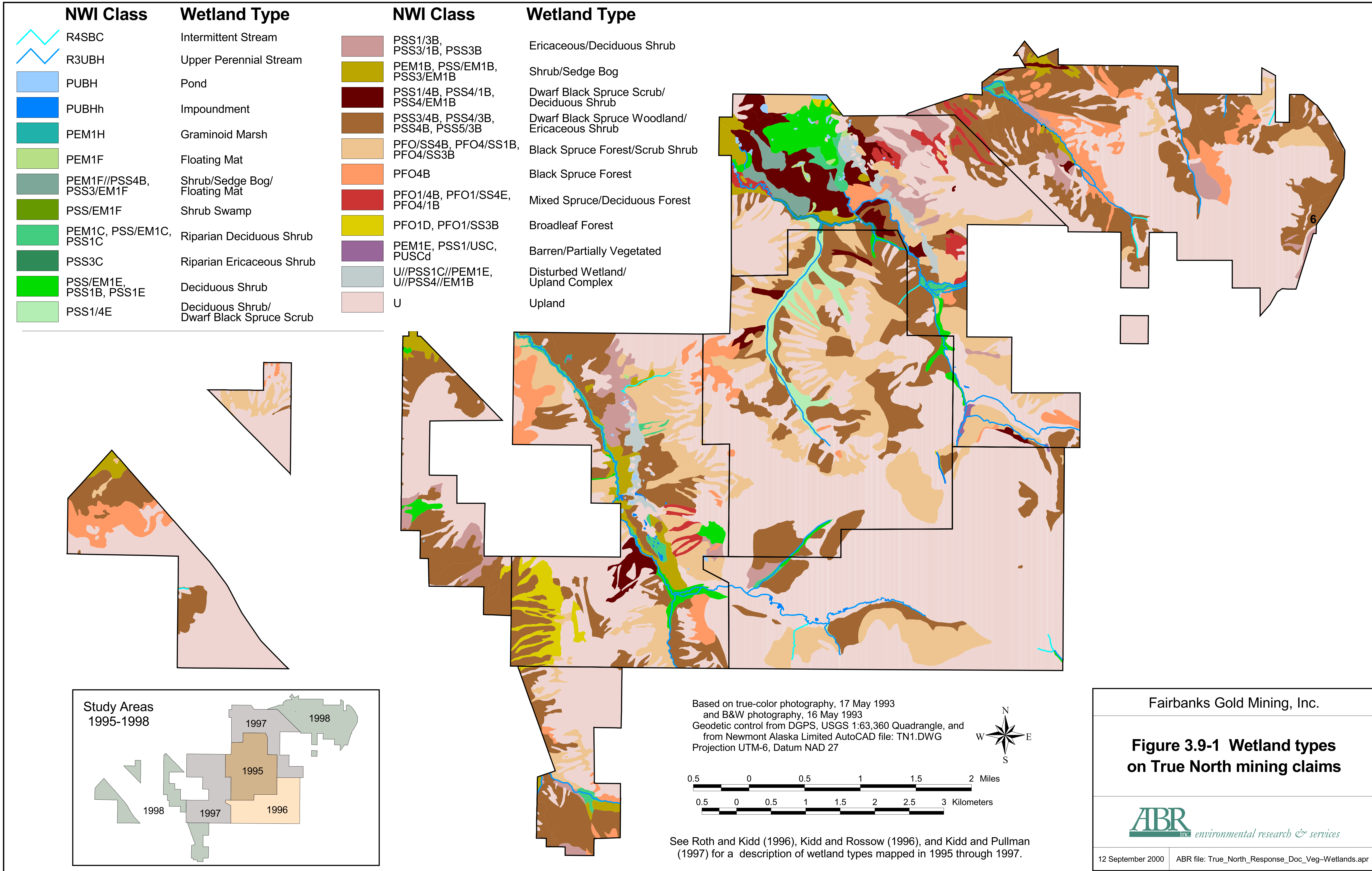


Figure 3.9-1 Wetland types on True North mining claims

Table 3.9-1
Wetland types, NWI code, and area of each type found on the True North mining claims

Wetland Type	NWI Code	Area		Percent of Total
		Hectares	Acres	
Intermittent Stream	R4 SB C	1.11	2.74	0.02
Upper Perennial Stream	R3 UB H	12.36	30.54	0.17
Pond	P UB H	10.95	27.06	0.15
Pond (Impoundment)	P UB Hh	5.16	12.75	0.07
Graminoid Marsh	PEM 1 H	0.89	2.20	0.01
Floating Mat	PEM 1 F	5.56	13.74	0.08
Shrub/Sedge Bog/Floating Mat	PEM 1 F//PSS 4 B	11.73	28.98	0.17
	PSS 3/EM 1 F	19.90	49.17	0.28
Shrub Swamp	PSS/EM 1 F	0.83	2.05	0.01
Riparian Deciduous Shrub	PEM 1 C	0.70	1.73	0.01
	PSS/EM 1 C	26.67	65.90	0.38
	PSS 1 C	31.19	77.07	0.44
Riparian Ericaceous Shrub	PSS 3 C	9.76	24.12	0.14
Deciduous Shrub	PSS/EM 1 E	6.19	15.30	0.09
	PSS 1 B	85.97	212.43	1.21
	PSS 1 E	21.69	53.60	0.31
Deciduous Shrub/Dwarf Black Spruce Scrub	PSS 1/4 E	64.55	159.50	0.91
Ericaceous/Deciduous Shrub	PSS 1/3 B	46.32	114.46	0.65
	PSS 3/1 B	97.45	240.80	1.37
	PSS 3 B	29.88	73.83	0.42
Shrub/Sedge Bog	PEM 1 B	13.93	34.42	0.20
	PSS/EM 1 B	23.26	57.48	0.33
	PSS 3/EM 1 B	83.41	206.11	1.17
Dwarf Black Spruce Scrub/ Deciduous Shrub	PSS 1/4 B	9.94	24.56	0.14
	PSS 4/1 B	125.25	309.49	1.76
	PSS 4/EM 1 B	34.02	84.06	0.48
Dwarf Black Spruce Woodland/ Ericaceous Shrub	PSS 3/4 B	529.15	1307.53	7.44
	PSS 4/3 B	748.08	1848.50	10.52
	PSS 4 B	214.02	528.84	3.01
	PSS 5/3 B	9.27	22.91	0.13
Black Spruce Forest/Scrub Shrub	PFO/SS 4 B	461.78	1141.06	6.49

Table 3.9-1

Wetland types, NWI code, and area of each type found on the True North mining claims (cont'd)

Wetland Type	**NWI Code**	**Area**		**Percent of Total**
		Hectares	**Acres**	
	PFO4/SS 1 B	207.70	513.23	2.92
	PFO4/SS 3 B	266.48	658.47	3.75
Black Spruce Forest	PFO 4 B	280.44	692.97	3.94
Mixed Spruce/Deciduous Forest	PFO 1/4 B	29.75	73.51	0.42
	PFO 1/SS 4 E	8.37	20.68	0.12
	PFO 4/1 B	22.33	55.18	0.31
Broadleaf Forest	PFO 1 D	4.05	10.01	0.06
	PFO 1/SS 3 B	60.66	149.89	0.85
Barren/Partially Vegetated	PEM 1 E	4.03	9.96	0.06
	PSS 1/USC	3.94	9.74	0.06
	PUS C d	0.81	2.00	0.01
Disturbed Wetland/Upland Complex	U//PSS 1 C//PEM 1 E	18.21	45.00	0.26
	U//PSS 4/EM 1 B	26.66	65.88	0.37
Upland[1]	U	3,435.69	8,489.59	48.32
Total Area		7,110.09	17,569.03	100.00

1 Includes ~ 60.6 ha (150 acres) of non-wetland disturbed areas

3.10 SURFACE DISTURBANCE

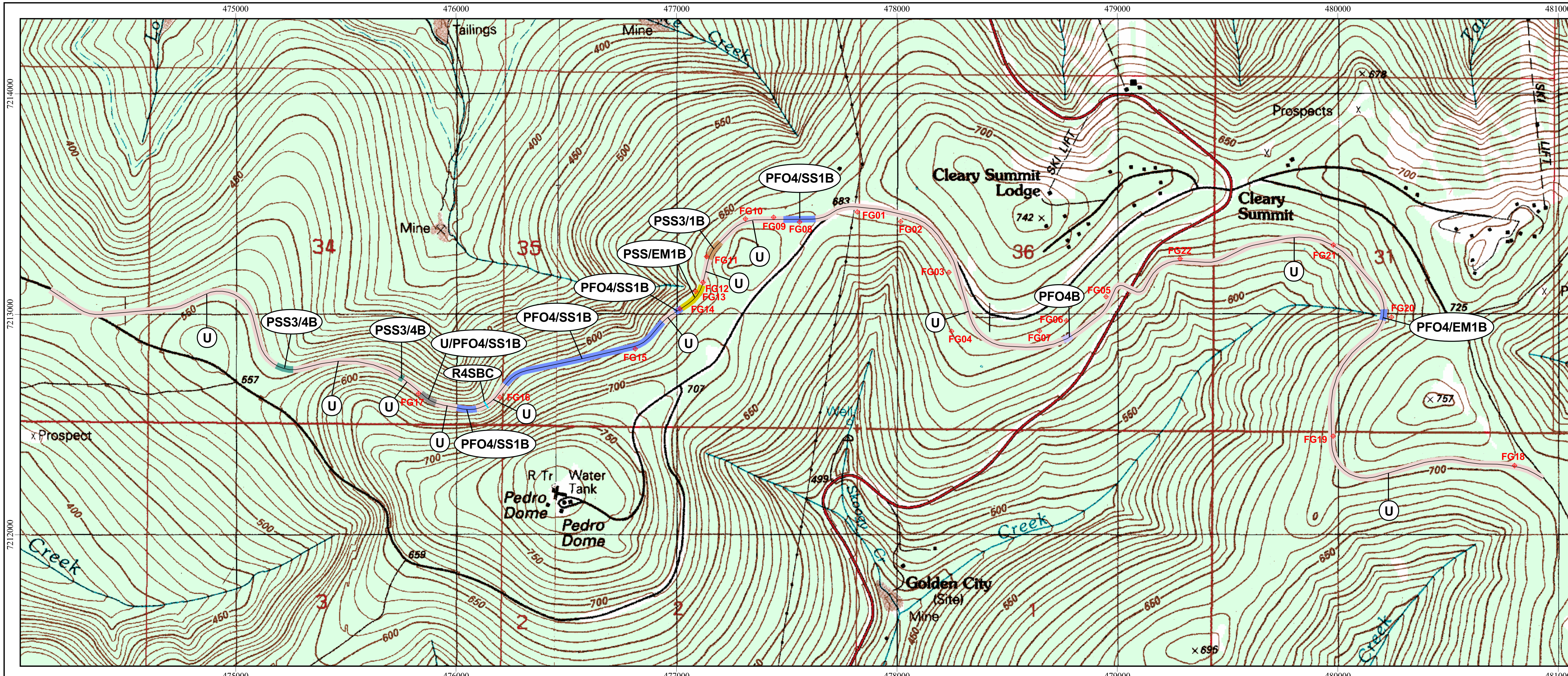
Based on the vegetation analysis of the True North project area conducted by ABR, Inc. from 1995 to 1998 (Table 3.9-1), human disturbance has occurred on approximately 253 acres (105.5 ha), or 1.5 percent of the area, largely from previous mining activity, including placer mine tailings and ponds in Eldorado and Dome creeks (Anderson et al., 1998). The major portion of existing disturbance within the mine permit area is located in the vicinity of the Hindenburg and East pits.

3.11 FISH

The proposed mine site is located on a ridge that drains south and southwest into Murray Creek, a tributary of Dome Creek, and to the west into Spruce Creek and to the east into Louis Creek, respectively, both tributaries of Little Eldorado Creek to the north. Both Dome and Little Eldorado creeks flow into the Chatanika River.

Upper Dome Creek, both above and below its confluence with Murray Creek, was historically placer mined and now flows through and around old tailings piles and ponds. Spruce Creek has had no significant influence from mining. Lower Louis Creek, as well as upper Little Eldorado Creek, also were historically placer mined and the creeks also flow through and around old tailings piles and ponds.

The only stream near the proposed mine site that is designated as anadromous is the Chatanika River itself, approximately 3 miles from the proposed mine site at its closest point to the north (Alaska Department of Gish and Game [ADFG], 1998). The stretch of the Chatanika River in the vicinity of the project area supports chinook (king) salmon, spawning and rearing Arctic grayling (*Thymallus arcticus*) as well as round whitefish rearing (*Prosopium cylindraceum*), sheefish spawning (*Stenodus leucichthys nelma*), and broad whitefish (*Coregonus nasus*), humpback whitefish (*Coregonus clupeaformis*), and least cisco (*Coregonus sardinella*) (ADFG, 1986).



NWI Class	Wetland Type
R4SBC	Intermittent Stream
PSS/EM1B	Open Tall Alder Shrub
PSS3/1B	Open Tall Birch Shrub
PSS3/4B	Open Dwarf Black Spruce Forest
PFO4/EM1B	Black Spruce Woodland
PFO4/SS1B, PFO4B	Open Black Spruce Forest
U/PFO4/SS1B	Upland/Black Spruce Woodland
U	Upland

Map Key

- Field Delineation Site
- Proposed Road Centerline
- 100-foot Proposed Road Corridor

Road alignment from Fairbanks Gold Mining, Inc. AutoCAD file
Base map: USGS 1:24,000 DRG, Livengood A-1 SW and A-2 SE
Projection: UTM-6; Datum: Nad27
Grid: 1,000 meters

0.5 0 0.5 1 1.5 Kilometers

0.25 0 0.25 0.5 0.75 1 Miles

N W E S

Fairbanks Gold Mining, Inc.

Figure 3.9-2 Wetland types along proposed True North ore haul road

ABR inc. environmental research & services

12 September 2000 | True_North_Response_Doc_Access.apr

Dome and Little Eldorado creeks are relatively inaccessible to people and fish surveys of these drainages have not been done. Some of the above species, however, may be present in these streams.

3.12 WILDLIFE

The True North project area lies within six miles of the Fort Knox Mine and is composed of very similar habitat. Thus, bird and mammal species and distributions are likely to be very similar. The following descriptions are largely based on information contained in the Fort Knox Mine EA (FGMI, 1993), augmented by observations made by ABR, Inc. during its 1995 to 1998 threatened and endangered species studies in the True North project area (Anderson et al., 1995, 1996, 1997, 1998).

3.12.1 BIRDS

Avian habitat in the project area is typical of upland areas of interior Alaska. According to the Kessel habitat classification system (Kessel, 1979), project area habitats include medium- and tall-shrub thickets, broadleaf forest, coniferous forest, mixed broadleaf- coniferous forest, scattered woodland, and artificial habitat (Dames & Moore, 1991). Spindler and Kessel (1980) studied bird habitat use in detail in parts of the upper Tanana River Valley and recorded habitats similar to those of the True North project area. Bird species documented from that study as well as species documented in the nearby Fort Knox project area are listed in Table 3.12-1.

Passerines. Spindler and Kessel (1980) documented a total of 36 species of passerines birds in terrestrial habitats of the Upper Tanana River Valley. Of these birds, 24 species have been recorded in the Fort Knox project area (Dames & Moore, 1991). Although the number of observations was insufficient to delineate habitat affinities, riparian tall-shrub communities are obviously important passerine habitat (Dames & Moore, 1991).

Waterbirds. Waterbird habitat in the project area is very limited because there are no naturally occurring lakes or large ponds. Existing habitat is very limited and primarily confined to old settling ponds and impoundments related to placer mining.

Raptors. Four species of raptors were documented in the nearby Fort Knox project area (FGMI, 1993) and are very likely found in the True North project area. These were the Northern Goshawk, Sharp-shinned Hawk, Great Horned Owl, and Red-tailed Hawk (Harlan's Hawk). The Red-tailed Hawk was the most commonly sighted raptor. Nesting Northern Goshawks were seen on the True North project area, and active nests were documented by Anderson et al. (1998). The Northern Goshawk is considered a sensitive species across its range in Alaska and is discussed below in Section 3.13 (Threatened and Endangered Species).

3.12.2 MAMMALS

The project area supports a mammalian fauna typical of upland taiga habitats of interior Alaska. Mammals common to this area are listed in Table 3.12-2.

Small mammals. The red squirrel (*Tamiasciurus hudsonicus*) is common throughout the project area in habitats with a substantial spruce component, such as the mixed-forest and needleleaf woodland habitat.

Beavers (*Castor canadensis*) may be present in small numbers in Dome and Eldorado creeks, likely at the mouths of old placer mining settling ponds, and perhaps across the main stream channel of these streams. Dams would occur in areas of low stream gradient. Trapping is unlikely to influence population size because the area is accessible by road.

Snowshoe hares (*Lepus americanus*) are common and are distributed throughout upland habitats, especially in riparian tall-shrub and mixed broadleaf-coniferous forest (Dames & Moore, 1991). Abundance of this species is cyclical and may change considerably over time. Anderson et al. (1998) reported that snowshoe hare numbers in the True North project area have increased since 1997, and appear to be following the regional trend of increasing hare population in interior Alaska (Taylor, 1996).

Table 3.12-1
Bird species of Alaska taiga in the upper Tanana Valley and the True North project area

Species	Upper Tanana	True North project area
Mallard	x	x
Pintail	x	x
Green-winged Teal	x	x
Bufflehead	x	x
Sharp-shinned Hawk	x	x
American Kestrel	x	—
Spruce Grouse	x	x
Ruffed Grouse	x	—
Sandhill Crane	x	—
Common Snipe	x	x
Solitary Sandpiper	x	—
Spotted Sandpiper	x	x
Lesser Yellowlegs	x	—
Great Horned Owl	x	x
Hawk Owl	x	—
Belted Kingfisher	x	x
Common Flicker	x	x
Hairy Woodpecker	x	—
N. Three-toed Woodpecker	x	—
Alder Flycatcher	x	x
Hammond's Flycatcher	x	—
Olive-sided Flycatcher	x	x
Violet-green Swallow	x	—
Tree Swallow	x	x
Bank Swallow	x	x
Cliff Swallow	x	—
Gray Jay	x	x
Common Raven	x	x
Black-capped Chickadee	x	x
Boreal Chickadee	x	—
Brown Creeper	x	x
American Robin	x	x
Varied Thrush	x	x
Hermit Thrush	x	x
Swainson's Thrush	x	x
Gray-checked Thrush	x	x
Ruby-crowned Kinglet	x	x
Water Pipit	—	x
Bohemian Waxwing	x	—
Orange-crowned Warbler	x	x
Yellow Warbler	x	x

Table 3.12-1 (cont'd)

Bird species of Alaska taiga in the upper Tanana Valley and the True North project area

Species	Upper Tanana	True North project area
Yellow-rumped Warbler	x	X
Townsend's Warbler	x	—
Blackpoll Warbler	x	—
Northern Waterthrush	x	—
Wilson's Warbler	x	x
Rusty Blackbird	x	—
Pine Grosbeak	x	—
Common Redpoll	x	x
Savannah Sparrow	x	x
Dark-eyed Junco	x	x
Tree Sparrow	x	x
White-crowned Sparrow	x	x
Fox Sparrow	x	x
Lincoln's Sparrow	x	x

Source: Spindler and Kessel, 1980; Dames & Moore, 1991a.

Table 3.12-2

Common mammal species of interior Alaska and the True North project area

Species	Scientific Name
Shrew	*Sorex* spp.
Voles, mice, and lemmings	Clethrionomys rutilus, Microtus spp., Synaptomys borealis, and Lemmus trimucronatus
Northern flying squirrel	Glaucomys sabrinus
Red squirrel	Tamiasciurus hudsonicus
Snowshoe hare	Lepus americanus
Beaver	Castor Canadensis
Porcupine	Erethizon dorsatum
Ermine	Mustela erminea
Marten	Martes Americana
Mink	Mustela vison
Wolverine	Gulo gulo
Coyote	Canis latrans
Red fox	Canis vulpes
Wolf	Canis lupus
Lynx	Felis lynx
Black bear	Ursus americanus
Brown bear	Ursus arctos
Moose	Alces alces

Source: ADFG 1973; Hall, 1981; Beasely, 1990; McNay, 1990; Dames & Moore, 1991.

Large mammals. Black bears (*Ursus americanus*) are likely to be seen in any habitat during the spring, summer, or fall (ADFG, 1973; America North, Inc., 1991; Dames & Moore, 1991). Black bears avoid open areas and extensive areas of dense timber, preferring open forest habitats that provide cover and food species such as berries, succulent forbs, and grasses (USFWS, 1980; Modaferri, 1978). Carrion and human refuse also are used when available (Hatler, 1967). Territories of individual bears vary considerably in size, depending on abundance of food, cover, and topography; for example, on the basis of the Kenai Peninsula studies (Schwartz and Franzmann, 1980), sows with cubs use from 9 square kilometers (3.5 square miles) to 26 square kilometers (10 square miles) and adult males use as much as 52 square miles (134.7 square kilometers).

Brown bears (*Ursus arctos*) are less common in the project area than black bears, but do occur in small numbers in the region (Dames & Moore, 1991). Brown bears can be found in any habitat type, but prefer open areas. They are typically solitary animals (USFWS, 1980). Isolation from human disturbance is an important factor in brown bear habitat use. Territories of brown bears are substantially larger than those of black bears, and range from 9.3 square miles to 14.7 square miles (Dean, 1957).

The moose (*Alces alces*) is the most abundant large game species in the project area. The lower valley bottoms are winter moose concentration areas (ADFG, 1973. McNay, 1990). Moose reside in the project area throughout the year. Most use occurs during the winter, but in areas lower than the proposed mine site (Young, 2000). Many of the moose that winter in the lower project area move to still lower elevations each spring and calve in the Chatanika River flats, remaining in lowland habitats until fall. By late October, moose have moved to higher elevations in the foothills around Fairbanks, including lower portions of project area, where they winter (McNay, 1990).

Based on browse transects in similar habitats in the Fort Knox project area, winter habitat use by moose would be greatest in the riparian tall-shrub communities along the stream courses, especially in revegetated tailing piles and old overgrown settling at elevations below the proposed mine site. Habitats with a lower value for wintering moose would be the closed mixed-forest and the needleleaf woodlands generally at higher elevations. Availability of browse species in these habitats, primarily willows (*Salix* spp.), is low, but moose likely would use a substantial proportion of what is available (Dames & Moore, 1991).

Data from browse transects at Fort Knox indicate that moose use essentially all available habitat types during the winter months. The major browse species were the feltleaf willow (*Salix alexensis*), diamondleaf willow (*S. planifolia*), grayleaf willow (*S. glauca*), and to a lesser extent, littletree willow (*S. arbusculoides*) and Bebb willow (*S. bebbiana*) (Dames & Moore, 1991a).

Browse becomes less important in a moose's diet as herbaceous vegetation becomes available in spring and summer (LeResche et al., 1974).

According to historical records (Murie, 1935), the project area is within the range of the Fortymile caribou herd (*Rangifer tarandus*). In the past, this herd was substantially larger (Skoog, 1956; Hemming, 1974). The closest caribou from the herd have come to the project area in recent years is approximately 30 miles to the east (McNay, 1990). In the winter of 1992-1993, several hundred caribou from the Delta caribou herd moved through Fairbanks proper and the surrounding area. Less than a dozen individuals are thought to have passed through the nearby Fort Knox project area. This is the first recordation in decades of members of this herd ranging this far to the northwest (FGMI, 1993).

The project area lies within Game Management Unit 20 B, and ADFG uniform coding unit (UCU) 208 that includes the watershed of the Chatanika River from Hard Luck Creek, approximately 10 miles west of Murphy Dome, upriver to the vicinity of Captain Bluff Camp, approximately 8 miles north-northeast of Cleary Summit.

Moose, beaver and lynx are the most common wildlife species harvested in UCU 208. ADFG moose harvest records for all of UCU 208 show a recent take of 27 (1997-98), 46 (1998-99) and 40 (1999-00). In 1997-98 and 1998-99, a combined total of 10 beavers was taken, as well as 39 lynx. Other species harvested included: black bear --13 (1995-96), 7 (1996-97), and 19 (1997-98); brown bear -- 1 in defense of life and property (1997-98); and 1 otter and 1 wolf in the two-year period 1998-99 to 1999-00.

UCU 208 encompasses an area of 353 square miles while all of the Dome and Little Eldorado creek drainages, within which the proposed project is located, cover approximately 30 square miles, or less than ten percent. Thus, although the actual location of the proposed project may host some hunting and trapping, it likely does not contribute a significant portion of the harvest in the UCU 208 area of the Chatanika River drainage.

3.13 THREATENED AND ENDANGERED SPECIES

Table 3.13-1 presents a list of the status and distribution of threatened and endangered species, and species of concern, in Alaska. Excluding marine mammals, only five species currently are listed as threatened or endangered in Alaska under the Endangered Species Act (ESA). One species is proposed for endangered status, and one species, the American Peregrine Falcon (*Falco peregrinus anatum*), was "delisted" in August of 1999. None of these species is found in the True North project area.

Prior to 1996, the U. S. Fish and Wildlife Service (USFWS) also maintained lists of candidate species (in two categories) that, although not formally listed under the ESA, were under consideration for future listing. In February 1996, the USFWS reorganized the listing procedure and now maintains a single category of candidate species, which is defined as species that warrant listing based on the available scientific data (i.e., only those species previously on the Category 1 [C1] list). Only one species in Alaska is currently a proposed species, the Short-tailed Albatross (Table 3.13-1). Species formerly listed on the Category 2 (C2) list are now considered ”species of concern” under the new system. A species of concern is one for which the USFWS has available scientific information that indicates populations may be declining or facing threats (USFWS, 1996). Although these species are not legally protected under the ESA, the USFWS does monitor their status, and “…encourages surveys and research on these species and implementation of management practices that would stop population declines and/or alleviate threats in order to preclude the need for listing” (USFWS, 1996).

Of the 31 species of animals and plants in Alaska listed as species of concern, 9 are known to occur in interior Alaska (Table 3.13-1): 1 mammal: lynx (*Felis lynx canadensis*); 3 birds: Peregrine Falcon (*Falco peregrinus anatum),* Harlequin Duck (*Histrionicus histrionicus*), and Olive-sided Flycatcher *(Contopus cooperi*); and 5 plants: (*Aster yukonensis*, *Cryptantha shackletteana*, *Draba murrayi*, *Eriogonum flavum* var. *aquilinum*, and *Podistera yukonensis*).

Table 3.13-1. Status and distribution of threatened and endangered species and species of concern in Alaska	
Status /Taxonomic Group / Species [1]	**Range in Alaska**
ENDANGERED SPECIES	
Plants	
Aleutian shield fern (*Polystichum aleuticum*)	Adak Island
THREATENED SPECIES	
Aleutian Canada Goose (Branta canadensis leucopareia)	Aleutian and Semidi islands
Spectacled Eider (*Somateria fischeri*)	Western and Northern (coastal)
Steller's Eider (Polysticta stelleri)	Southwestern, Western, & Northern
PROPOSED ENDANGERED	
Short-tailed Albatross (*Diomedea albatrus*)	Gulf of AK, Aleutian Is., Bering Sea
SPECIES OF CONCERN [2]	
Mammals	
Glacier Bay water shrew (*Sorex alaskanus*)	Glacier Bay
Pribilof Islands shrew (*Sorex hydrodromus*)	Pribilof Islands
Amak tundra vole (Microtus oeconomus amakensis)	Amak Island
Montague tundra vole (Microtus oeconomus elymocetes)	Montague Island
North American lynx (*Felis lynx canadensis*)	Statewide
Alexander Archipelago wolf (*Canis lupus ligoni*)	Southeast
Birds	
Perigrine Falcon (Falco peregrinus anatum)	Stateside
Harlequin Duck (Histrionicus histrionicus)	Statewide
Northern (Queen Charlotte) Goshawk (*Accipiter gentilis laingi*)	Southeast
Bristle-thighed Curlew (*Numenius tahitiensis*)	Western
Red-legged Kittiwake (*Rissa brevirostris*)	Pribilof, Buldir, and Bogoslof Is.
Evermann's Rock Ptarmigan (*Lagopus mutus evermanni*)	Attu Island
Yunaska Rock Ptarmigan (*Lagopus mutus yunaska*)	Yunaska I.
Kittlitz's Murrelet (Brachyramphus brevirostris)	South and Southeast
Marbled Murrelet (Brachyramphus marmoratus)	South and Southeast

Table 3.13-1 (con'td) **Status and distribution of threatened and endangered species and species of concern in Alaska**	
Status /Taxonomic Group / Species [1]	**Range in Alaska**
Olive-sided Flycatcher (*Contopus cooperi*)	Central, Southern, and Southeast
Amphibians	
Spotted frog (*Rana pretiosa*)	Southeast
Fish	
Bull trout (Salvelinus confluentus)	Southeast
Plants	
Artemisia globularia var. lutea	St. Paul I., St. Matthew I.
Aster yukonensis	Bettles area
Botrychium ascendens	Southeast and Southcentral
Carix lenticularis var dolia	Southeast
Cryptantha shackletteana	Eagle area
Draba murrayi	Eagle area
Eriogonum flavum var. aquilinum	Eagle area
Mertensia drummondii	Atqasuk/Umiat area
Oxytropis arctica var. barnebyana	Kotzebue area
Podistera yukonensis	Eagle area
Primula tschuktschorum	Western Seward Peninsula
Rumex krausei	Point Hope area, W. Seward Pen.
Smelowksia pyriformis	Upper Kuskokwim River
Taraxacum carneocoloratum	Southcentral, including AK Penin.

1 Species in bold occur in interior Alaska.

2 Species of concern are from USFWS (1996).

Although only the Queen Charlotte population (found in Southeast Alaska) of Northern Goshawks is listed as a species of concern, the goshawk is considered to be a sensitive species across its range in Alaska.

There are no listed threatened or endangered species of fish in Alaska and only one species of concern, in southeast Alaska.

From 1995 to 1998, ABR, Inc. conducted four reconnaissance evaluations of species of concern in the True North project area, and a detailed description of those findings can be found in (Anderson et al., 1995, 1996, 1997, 1998).

3.13.1 SPECIES OF CONCERN

Lynx

North American lynx occur in most of the boreal regions of northern North America, including Alaska (Tumlison, 1987). Lynx are found throughout Alaska except on the Aleutian Islands, islands in the Bering Sea and Gulf of Alaska, some islands in Prince William Sound, and on some islands in southeastern Alaska (Berrie et al., 1994). Lynx are found most often in forested habitats, including mixed spruce–hardwood forests, open spruce muskegs, and aspen–spruce woodlands, but they occur occasionally in shrub habitats (Berrie, 1973; Stephenson, 1986). Open habitats tend to be avoided by lynx (Stephenson, 1986). The primary prey of lynx is the snowshoe hare that fluctuates in abundance on an approximate 10-year cycle in interior Alaska (Wolff, 1980).

Lynx would be expected to be found in the True North project area. A lynx was seen in June 1997 near Pedro Dome, and two additional lynx sightings were reported in the area: one crossing the Old Elliott Highway at Dome Creek during April and one near the Elliott Highway where it crosses Dome Creek (Anderson et al., 1997). The large number of snowshoe hares seen in the area in 1998 suggest that lynx probably are actively using the area. Trapping records for the general area (UCU area 0208 of Game Management Unit 20B) during the past several years indicate that the lynx population was in the declining phase of the cycle through winter 1994–1995, but that the population is now rebounding, presumably in response to increasing snowshoe hare numbers in the area (Taylor 1993, 1994, 1996; Tom Seaton, ADFG, pers. comm.).

Peregrine Falcon

No Peregrine Falcons were seen during the aerial or ground surveys in the project area during the 1995 to 1998 studies. The *anatum* subspecies of the Peregrine Falcon nests in interior Alaska on river cliffs and on rock outcroppings in upland areas adjacent to rivers and larger streams (Cade, 1960, Ambrose et al., 1988). Our initial evaluation of habitats from photo-interpretation of aerial photographs of the 1998 study area indicated that these habitats do not occur in the study area, and our site visit confirmed this assessment. Thus, Peregrine Falcons are unlikely to breed, or regularly occur, in the True North project area.

The nearest nesting peregrines are on the lower Chena River near Moose Creek Dam (Roseneau et al., 1981) and on Birch and Beaver creeks (Kuropat, 1986, Ritchie et al., 1994). As populations have increased in recent years, however, peregrines have been reinhabiting their historical range in interior Alaska, and off-river (i.e., away from the Tanana

and Yukon rivers) nest sites occupied by nesting peregrines have been located in the White Mountains and other isolated upland areas (where suitable cliffs or rock outcroppings are present) to the north of the study area (Kuropat, 1986, Ritchie et al., 1994). Even given the slowly expanding breeding population in interior Alaska, it is highly unlikely that peregrines will nest in the True North area because suitable cliff-nesting habitats do not occur there.

Although Peregrine Falcons may pass through the vicinity of the proposed project occasionally during migration, there is no reason to suspect that the project area would be used regularly by migrating falcons for hunting, staging, or as a migration corridor.

Northern Goshawk

While the Northern Goshawk is not listed as a species of concern, it is considered to be a sensitive species across its range in Alaska. The goshawk is a resident raptor in interior Alaska, feeding primarily on grouse and snowshoe hares (Gabrielson and Lincoln, 1959; Zachel, 1985; Doyle and Smith, 1994; Iverson et al., 1996). In interior Alaska, McGowan (1975a) found that paper birch (*Betula papyrifera*) woodlands were the preferred nesting habitat for goshawks. Most (76%) of the nests were in birch trees; primarily on southern or western exposures. McGowan conducted his study partially in areas south of the True North project area, and his study sites comprised similar terrain and habitats. In addition, nests were found in the right-of-way corridor of the proposed Northwest Alaska Gas Line during surveys conducted in 1979–1981 (Roseneau and Bente, 1981; Ritchie 1981). This corridor paralleled the existing Trans-Alaska Pipeline System, which is located immediately to the west of the True North project area (Anderson et al., 1998).

Suitable forest types for goshawks (McGowan 1975b) occur throughout the True North project area, including mixed birch and spruce stands, and homogenous stands of aspen in the uplands and along the drainages of Spruce and Dome creeks. These forest stands constitute fair-to-high quality habitat for nesting goshawks, and do support goshawks when prey species (snowshoe hares and grouse) are present. Prey numbers in the area presently seem sufficient and snowshoe hare numbers (based on sightings and carcasses) in the True North project area have increased since 1997, and appear to be following the regional trend of increasing hare populations in interior Alaska (Taylor 1996).

Annual surveys in the True North project area from 1995 through 1998 identified three different goshawk nests (Fig. 3.8-1) (Anderson et al., 1998). One was active in 1996, another active in 1997 but inactive in 1998, and the third active in 1998. The nests were located approximately 6,500, 1,000, and

16,600 feet, respectively, from the closest point of a proposed project activity, a storage pile on the western side of the Hindenburg Pit.

Olive-sided Flycatcher

The Olive-sided Flycatcher is a small passerine bird that breeds in the boreal forests of North America (including Alaska) and winters in the forests of Central and South America (Gabrielson and Lincoln, 1959; AOU, 1983; Willis et al., 1993). In general, neotropical migrant birds (i.e., those birds that breed in North America and migrate long distances to winter in the Central and South American tropics) appear to be declining in abundance in their breeding ranges in North America, particularly the eastern United States and Canada (Sauer and Droege, 1992). A major cause of these declines appears to be deforestation and habitat alterations to the tropical broadleaf forests used by these birds, including the Olive-sided Flycatcher, in their wintering areas (Petit et al., 1993).

In interior Alaska Olive-sided Flycatchers usually breed in forested habitats, particularly coniferous forests dominated by black spruce, although they also can be found in low numbers in mixed deciduous–coniferous forests (Spindler, 1976; Spindler and Kessel, 1978; Kessel et al., 1982; ABR, 1987). Kessel (1979) identified scattered woodlands (trees ≥5 m tall) and dwarf forest (trees <5 m tall) as typical habitats of the Olive-sided Flycatcher

Surveys in the True North project area from 1996 to 1998 identified several Olive-sided Flycatchers each year (Fig. 3.8-1) (Anderson et al., 1995, 1996, 1997, 1998). Most of these birds were in needleleaf forests. The results of the surveys indicate that Olive-sided Flycatchers generally are present wherever suitable habitats occur in the True North project area. As shown in Figure 3.8-1, two territories are located in areas that would be disturbed by the proposed project pits or stockpiles, and an additional two or three are located within approximately 4,000 feet of such disturbance.

Harlequin Duck

The Harlequin Duck is a sea duck that breeds primarily in the coastal habitats of the Pacific Northwest and along fast-moving streams in the mountains of interior Alaska and western Canada (Bellrose, 1978). Harlequin Ducks are common in coastal areas of southeastern and southcentral Alaska and in the Aleutians, but are less common north of the Alaska Peninsula and in interior Alaska (Gabrielson and Lincoln, 1959). Records summarized by Gabrielson and Lincoln indicate that Harlequin Ducks have been recorded in the swift upper tributaries of Beaver Creek. More recently, harlequins have been reported breeding along the Fortymile River and along fast-moving streams in the White Mountains (D. D. Gibson, Univ. Alaska Museum, Terrestrial Vertebrates Collection, pers. comm.). Gibson also indicated that Harlequin Ducks, although not common, are likely to occur in all suitable habitats in interior Alaska that are undisturbed by human activities.

Anderson et al. (1998) indicated that habitats suitable for Harlequin Ducks (primarily swift-moving streams) do not occur in the True North project area. Thus, it is extremely unlikely that this species would occur in these areas. In addition, Anderson et al. (1998) stated no site records of this species have been reported in the area (D. D. Gibson, pers. comm.).

Plants

Four of the five plant species of concern (Cryptantha shackletteana, Draba *murrayi*, *Eriogonum flavum* var. *aquilinum*, and *Podistera yukonensis*; Table 3.13-1) occur in interior Alaska, but are restricted to steep, south-facing bluffs composed of steppe-like vegetation overlying well-drained eolian silts (Murray and Lipkin, 1987; C. Parker, Univ. Alaska Museum, Herbarium Collection, pers. comm.). Dry, south-facing bluffs supporting this plant community type are not present in the True North project area. The fifth plant species (*Aster yukonensis*) occurs on well-drained river and stream banks and river delta gravels, but has been found only along the Koyukuk River drainage in the Brooks Range and near Kluane Lake in the Yukon (Murray and Lipkin, 1987).

3.14 AIR QUALITY

3.14.1 METEOROLOGICAL CONDITIONS

The project area is near the center of the climatological division known as the Interior Basin of Alaska. This part of Alaska has extreme seasonal variations in temperature. Daily minimum readings drop to 0°F or colder more than 75 percent of the days from November 1 to March 31 (U.S. Department of Agriculture, 1963). Daily maximum readings reach 70°F or higher about 56 percent of the days in July and August. Temperatures can reach 90°F or higher at some time approximately 20 percent of the days during the growing season (FGMI, 1993).

Precipitation data for Fairbanks indicate that historically the wettest months are June, July, August, and September (National Oceanic and Atmospheric Administration, 1989). August, the wettest month, has a mean precipitation of 1.86 inches. The driest months are February, March, and April. With a mean precipitation of 0.27 inches, April is the driest month. Annual mean precipitation for Fairbanks is 10.37 inches (FGMI, 1993).

Interior Alaska is dominated by high pressure 7 to 8 months of the year and by low pressure during the summer months. Daily sunlight varies from less than 3.5 hours to more than 20 hours (FGMI, 1993).

The project area is characterized by low cloud cover and light winds. In winter, the high pressure results in calm wind conditions. On an annual basis, the regional wind pattern is from the north, except during June and July, when it is from the southwest. Annual regional wind speed is approximately 5 miles per hour (FGMI, 1993).

These meteorological and climatological conditions suggest that the Fairbanks area is characterized by limited atmospheric-mixing conditions. Strong ground-based inversions in winter further inhibit vertical dispersion of air emissions.

Because the project area is located in hilly terrain, local meteorological conditions could differ from regional climatology.

3.14.2 EXISTING AIR QUALITY

Air quality is regulated through ambient air quality standards and enforcement of emission limits for individual sources of air pollution. The federal Clean Air Act required EPA to identify National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. These standards have been established for TSP, particulate matter (PM_{10}), ozone (O_3), carbon monoxide (CO), SO_2, nitrogen dioxide (NO_2), and lead (Pb). The State of Alaska has adopted the NAAQS. These standards are presented in Table 3.14-1 (FGMI, 1993).

On the basis of air quality data collected at Fairbanks, and recognizing that the True North project area is away from any populated or industrial area, concentrations of criteria pollutants are expected to be lower than corresponding values reported in Fairbanks, and certainly would ot approach the NAAQS standards. Because the project area is substantially above the elevation of Fairbanks, temperature inversions and associated ice fog are not expected to occur at the project site (FGMI, 1993). Table 3.14-2 shows typical air pollutant background concentrations in rural Fairbanks.

Table 3.14-1 **National Ambient Air Quality Standards**			
Pollutant	**Averaging Time**	**Primary (Health)**	**Secondary (Welfare)**
Total suspended particulates (TSP)	Annual arithmetic mean	NA	60 $\mu g/m^3$
	24 hours	NA	150 $\mu g/m^3$
Particulate matter less than 10 μm diameter (PM_{10})	Annual arithmetic mean	50 $\mu g/m^3$	50 $\mu g/m^3$
Ozone (O_3)	1 hour	0.12 ppm	0.12 ppm
Carbon monoxide (CO)	8 hours	9 ppm	9 ppm
	1 hour	35 ppm	35 ppm
Sulfur dioxide (SO_2)	Annual arithmetic mean	0.03 ppm	NA
	24 hours	0.14 ppm	NA
	3 hours	NA	0.5 ppm
Nitrogen dioxide (NO_2)	Annual arithmetic mean	0.053	0.053
Lead (Pb)	Calendar quarter	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$

Table 3.14-2 **Typical Air Pollutant Background Concentrations In Rural Fairbanks**		
Pollutant	**Averaging Time**	**Concentrations**
TSP	Annual	Not available
	24 hour	42 $\mu g/m^3$
O_3	1 hour	0.05 ppm
CO	1 hour	Less than 5.0 ppm
	8 hour	Less than 1.0 ppm
SO_2	1 hour	Less than 0.01 ppm
	3 hour	Essentially the same as for 1 hour

Source: MacKenzie and Arnold, 1973; Coutts, 1979

3.15 NOISE AND VIBRATION

This discussion of the existing noise and vibration environment in the True North project area has been taken from the True North noise and vibration analysis contained in Minor & Associates (2000). Greater detail about methods of sound measurement and type of equipment used may be found in that document.

3.15.1 INTRODUCTION

Human response to noise is subjective and can vary greatly from person to person. Factors that can influence individual response include the loudness, frequency, the amount of background noise present before an intruding noise and the nature of the work or activity (e.g., sleeping) that the noise affects.

The unit used to measure the loudness of noise is the decibel (dB). To better approximate the sensitivity of the human ear to sounds of different of frequencies, the A-weighted decibel scale was developed. Because the human ear is less sensitive to higher and lower frequencies, the A-weighted scale reduces the sound level contributions of these frequencies. When the A-weighted scale is used, the decibel levels are denoted as dBA.

A 10-dBA change in noise levels is judged by most people as a doubling of sound level. The smallest change in noise level that a human ear can perceive is about 3 dBA, and increases of 5 dBA or more are usually noticeable. Normal conversation ranges between 44 and 65 dBA when speakers are 3 to 6 feet apart.

Noise levels in a quiet rural area at night are typically between 32 and 35 dBA. Quiet urban nighttime noise levels range from 40 to 50 dBA. Noise levels during the day in a noisy urban area are frequently as high as 70 to 80 dBA. Noise levels above 110 dBA become intolerable and then painful, while levels higher than 80 dBA over continuous periods can result in hearing loss. Constant noises tend to be less noticeable than irregular or periodic noises.

Table 3.15-1 provides some common noise sources with relative loudness and decibel rating.

3.15.2 Sound Propagation Characteristics

There are several factors that determine how sound levels reduce over distance. Under ideal conditions, a point noise source in free space will attenuate at a rate of 6 dB per doubling of distance (using the inverse square law). An ideal line source (such as constant flowing traffic on a busy highway) reduces at a rate of approximately 4.5 dB per doubling of distance. Under normal conditions however, noise sources are usually some combination of the two examples resulting in sound attenuation which lies somewhere between the two ideal reduction factors. Other factors that affect the attenuation of sound with distance include existing structures, topography, foliage, ground cover, and atmospheric conditions such as wind, temperature, and relative humidity. The following sections provide some general information on the potential affects of each of the factors on sound attenuation.

Existing Structures -- Existing structures can have a substantial affect on noise levels in any given area. Structures can reduce noise by physically blocking the sound transmission, and in some circumstances, can cause an increase in noise levels if the sound is reflected off the structure and transmitted to a nearby receiver location. Measurements have shown that a single story house has the potential, through shielding, to reduce noise levels by as much a 10 dB or greater. The actual noise reduction will depend greatly on the geometry of the noise source, receiver, and location of the structure. Increases in reflected noise are normally kept to 3 dB or less.

Topography -- Topography includes existing hills, berms, and other surface features between the noise source and receiver location. As with structures, topography has the potential to reduce or increase sound depending on the geometry of the area. Hills and berms when placed between the noise source and receiver can have a significant effect on noise levels. In many situations, berms are used as noise mitigation by physically blocking the noise source from the receiver location. In some locations, however, the topography can result in an overall increase in sound levels by either reflecting or channeling the noise towards a sensitive receiver location.

Foliage -- Foliage, if dense, can provide slight reductions in noise levels. The Federal Highway Administration (FHWA) provides for up to a 3 dBA reduction in traffic noise for locations with at least 30 feet of dense foliage that contains leaves year around. Because of the varying foliage in the project area, a minimal reduction for foliage was used in the analysis.

Ground Cover -- The ground cover between the receiver and the noise source can have a significant affect on noise transmission. For example, sound will travel very well across reflective surfaces such as water and pavement, but can be attenuated when the ground cover is field grass, lawns or loose soil. Appropriate ground coverage was used in the analysis, including powder snow, granular snow, and field grass.

Atmospheric Conditions -- Atmospheric conditions that can have an effect on the transmission of noise include wind, temperature, humidity and precipitation. Wind can increase sound levels if it is blowing from the noise source to the receiver, and conversely, can reduce noise levels if blowing in the opposite direction. Temperature, by itself, normally would have a small affect on noise levels; however, project area temperatures can vary from –40o F to 70o F. In addition, atmospheric conditions have the most noticeable affect on receivers located over 250 feet from the noise source, which is the case in the project area. Temperature variations of this magnitude, when grouped with humidity and pressure, can have a noticeable impact on noise levels as measured at distant receiver locations. Historical atmospheric conditions used in the analysis were obtained from the Fairbanks National Weather Service.

3.15.3 NOISE LEVEL DESCRIPTORS

General mining operational noise levels used in this analysis (with the exception of blast noise) are stated as sound pressure levels, in terms of decibels on the A-scale (dBA). The A-scale is used in most ordinances and standards including the applicable standards for this project. To account for the time-varying nature of noise several noise metrics are useful. The equivalent sound pressure level (L_{eq}) is defined as the average noise level, on an energy basis, for a stated time period (for example, hourly).

Other commonly used noise descriptors include the L_n, L_{max}, and L_{min}. The L_{max} and L_{min} are the greatest and smallest root-mean square (RMS) sound levels, in dBA, measured during a specified measurement period. The sound level descriptor L_n is defined as the sound level exceeded “n” percent of the time. For example, the L_{25} is the sound level exceeded 25 percent of the time; therefore, during a 1-hour measurement, an L_{25} of 60 dBA means the sound level equaled or exceeded 60 dBA for 15 minutes during that hour.

3.15.4 EXISTING LAND USE AND AMBIENT NOISE LEVELS

This section provides details on the area land use survey and noise monitoring. Thirteen locations were selected for the noise survey; six locations were primarily short-term monitoring and the other seven locations were long term unattended sites.

Project Area Land Use

Land use within a 5-mile radius of the True North Mine site includes residential, commercial, light and heavy industrial, as well as undeveloped lands. Major noise sources include existing mining operations, heavy truck traffic on the Elliott and Steese highways, snow machines in the winter, sled dog teams and tour buses in the summer months. Other less notable sources include passenger traffic and miscellaneous residential and commercial activities.

West and north of True North Mine site

Directly west of the proposed mine site is the Olnes East Subdivision. The Olnes East subdivision is located east of the old Elliott Highway, approximately 7 to 8 miles north of the intersection of the Elliott and Steese highways. The area is divided in to what recent FNSB CAD files show as over 60 individual lots. Several occupied single-family residences exist in this area. Distances between this development and the proposed mine site vary from approximately 5,000-feet at the east end of the subdivision to 12,000-feet at the west end of the subdivision. An additional 30 to 35 lots also were identified at the Olnes West subdivision, which is located on the west side of the Elliott Highway. The Olnes area is the closest residential area to the proposed mine site.

Two other nearby residential areas exist on the west side of the Elliott Highway in the same vicinity and south of the Olnes subdivisions. One group of approximately 30 lots is located along Babe Creek Drive, Treasure Street, and Wildcat Creek Way, all located off Vault Drive west of the Elliott Highway. The distance to the proposed mine site from this group of residents is approximately 15,500-feet. A second subdivision, located north of Wildcat Creek Way named Wanda's Acres, also is approximately 15,500-feet from the proposed mine site.

With the exception of some individual residents on otherwise undeveloped lands, the only other identified major residential area northwest of the proposed mine site is the Haystack Subdivision located along Haystack Ridge. The closest residents in this area are approximately 18,800-feet to 19,200-feet from the proposed site and, even though at this distance mine related noise is not expected to be audible, the area is included in this analysis.

East of True North

East of the proposed True North Mine site, along the Pedro Dome / True North Road and near the Clearly Summit area, there are several single-family residential areas and a ski resort. Approximately 35 residential lots were identified along Pedro Dome / True North Road, Ridge Run Road, and Rock Run Road. This residential area is approximately 17,600-feet to 18,800-feet from the mine site in the Cleary Summit Subdivision and is well shielded by the Pedro Dome Ridge. Another residential area, the Skiland Subdivision, is located east of the Steese Highway, over 22,000 feet from the mine site. As with the Cleary Summit Subdivision, residents of the Skiland Subdivision also are shielded from the True North mine site by Pedro Dome Ridge.

Several other single family residents also are located east/southeast of the mine site closer to the Steese and Elliott highways intersection at Fox, however, all of these residents are over 23,000-feet from the site and are well shielded by the existing topography and therefore not expected to have noticeable noise level increases related to the True North project.

3.15.5 EXISTING NOISE LEVEL SURVEY

Monitoring locations were selected based on the ability to gain access and to accurately document a group of nearby noise sensitive land uses. Other considerations, such as topography and existing noise sources also played a part in site selection. Based on the on-site investigation and site review, 13 locations were selected for noise monitoring.

For the purpose of performing the noise analysis, the noise monitoring was divided into two groups; locations that could be affected by activities at the True North mine site, and locations that could be affected by trucks on the ore haul route. Six monitoring locations were selected to represent the nearby residential areas for the analysis of True North Mine operations. Locations selected were two sites along the Elliott Highway, one in the Olnes Subdivision, one in the Haystack Subdivision, one near Pedro Dome, and one near Cleary Summit. Figure 3.15-1 shows the approximate location of the six monitoring sites used for the analysis of True North mine operations.

An additional seven locations were used to represent receivers near the proposed ore haul route. The monitoring locations were near the haul route in the Cleary Summit and Skiland residential subdivisions. Two locations were selected in the Cleary Summit Subdivision with an additional five locations selected in the Skiland Subdivision. Figure 3.15-2 shows the seven monitoring locations selected near the proposed haul route.

Because of extreme temperatures during January 2000 of minus 35 to minus 45 degrees F, all winter monitoring sessions were performed on a short-term, on-site basis. The benefit of performing short-term monitoring is that personnel on-site can make notes of existing noise sources, and take short special readings that can be used to approximate the expected nighttime noise levels. The winter data was only taken at the six representative sites selected for True North Mine operational noise (Fig. 3-15.1). No winter monitoring was performed at the sites along the proposed ore haul route because selection of the preferred route had not been made. For the purpose of the analysis and associated discussion, the term daytime is defined as 7:00 am to 10:00 pm and nighttime is defined as 10:00 pm to 7:00 am.

Short-term noise monitoring was also performed during the summer between July 10 and July 13, 2000 at each of the six sites selected for True North Mine operational noise. In addition to the short-term monitoring, summer long term unattended noise monitoring was also performed at the seven locations selected near the ore haul route (Fig. 3-15-2).

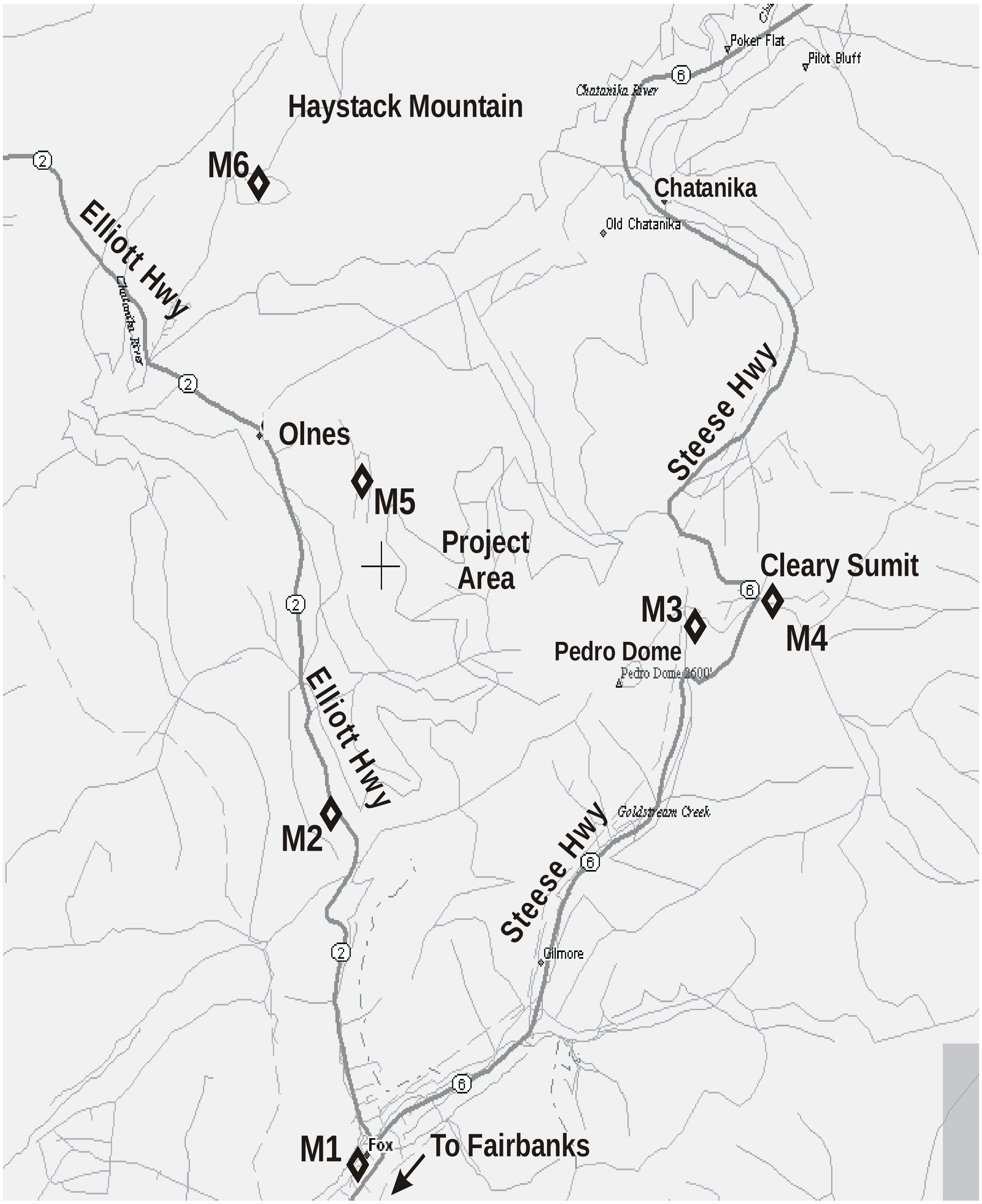


Figure 3.15-1

True North project area and short-term noise monitoring locations

Existing Noise Levels

The thirteen sites used as noise survey locations are shown on Figure 3.15-1 and Figure 3.15-2. Table 3.15-1 provides a summary of the measured levels. Following is a description of each of the survey results for each receptor site.

Site M1: Site M1 was located at the gas station near the intersection of the Steese and Elliott highways at Fox. Land use near this location includes commercial, industrial and undeveloped lands. Maximum L_{eq} noise levels near this site were measured at between 58 and 61 dBA L_{eq}. The highest noise levels and traffic volumes were recorded during the afternoon hours. The site was used mainly to assist in prediction of traffic along the two major highways near the True North and Fort Knox sites.

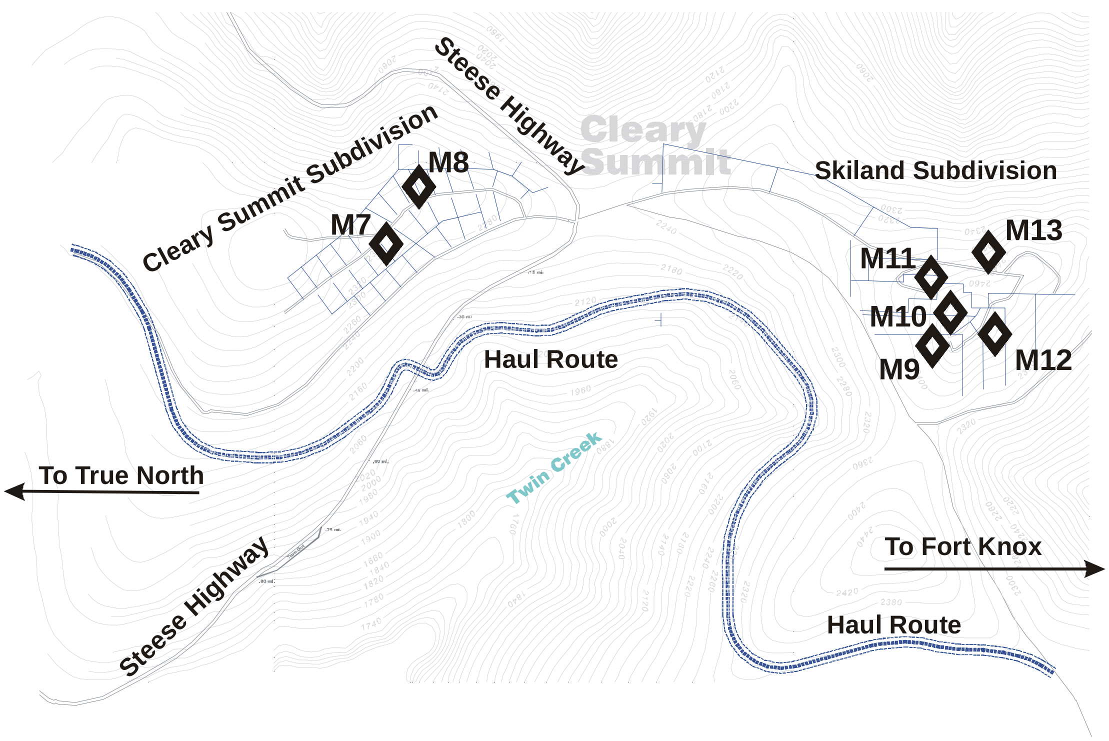


Figure 3.15-2

True North ore haul route and long-term noise monitoring locations

Table 3.15-1

Noise Monitoring Summary by Location and Nearby Land Use

Site No	Location	Land Use[1]	Daytime[2]	Nighttime[3]
M1	Intersection of the Steese Expy, Elliott Hwy	Com/Ind/Und	58 to 61	43 to 50
M2	Hilltop Truck Stop	Com/Und	60 to 65	40 to 45
M3	Residential area along Pedro Dome Rd	Res/Und	35 to 40	30 to 35
M4	Cleary Summit near the Steese Expy	Res/Com/Und	70 to 78	42 to 75
M5	Susan Wood Residence along Luneberg Rd.	Res/Und	31 to 35	30 to 35
M6	Haystack subdivision – Haystack & Leuthold Dr.	Res/Und	33 to 37	30 to 35
M7	Tom Walyer Residence – Cleary Summit	Res	33 to 68	25 to 55
M8	Brent LeValley Residence – Cleary Summit	Res	36 to 52	30 to 58
M9	Mt Aurora Fairbanks Creek Bed & Breakfast	Res	36 to 52	32 to 46
M10	Cleary Summit Bed & Breakfast	Res	34 to 70	32 to 44
M11	Lance Parrish Residence – Skiland	Res	33 to 50	32 to 38
M12	Mike Goulding Residence – Skiland	Res	44 to 58	42 to 48
M13	Skiland Lodge	Com	31 to 38	30 to 42

Land Use: Res = Residential; Com = Commercial; Ind = Industrial; Und = Undeveloped

Daytime is defined as 7 a.m. to 10 p.m.

Nighttime is defined as 10 p.m. to 7 a.m.

Site M2: Site M2 was at the Hilltop Truck Stop along the Elliott Highway. Land use near this location includes commercial and undeveloped lands. Maximum L_{eq} noise levels near this site were measured at 62 dBA L_{eq}. The highest noise levels were recorded during the afternoon hours. The site was used mainly to assist in prediction of traffic along the Elliott Highway.

Site M3: Site M3 was at the residential area along Pedro Dome / True North Road just west of the Ridge Run Road intersection. Noise sources in the area are dominated by residential activity, trucks and other vehicles on the Steese Highway, along with wind and birds (during summer months). Daytime average L_{eq} noise levels were measured at 40 dBA, and nighttime noise levels are projected at 34 to 37 dBA. Although noise from mining operations should not be audible at this location, this site is near the proposed ore haul route and monitoring was performed to assist in projecting potential truck noise impacts.

Site M4: Site M4 is at the "Y" intersection that connects the road to Fort Knox, the road to the, and the short connector road to the Steese Highway. Land use near this location includes rural residential, commercial, industrial and undeveloped lands. Peak hour L_{eq} levels of 78 dBA were measured and nighttime L_{eq} levels ranged between 42 and 75 dBA due to trucks along the roadway. As with site M3, noise from mining operations should not be audible at this location. This site is near the proposed ore haul route and monitoring was performed to assist in projecting potential truck noise impacts.

Site M5: Site M5 was at Susan Wood's residence located in Olnes subdivision, along Luneberg road, off the Old Elliott Highway. This location is one of the closest residential uses to the proposed site, and the monitored levels were used to represent several other residencess in the same area. Daytime L_{eq} noise levels were measured at 31 to 35 dBA and nighttime noise levels were projected at 30 to 35 dBA L_{eq}.

Site M6: Site M6 was located in the Haystack Subdivision north of the proposed mine site. The selected location was near the intersection of Haystack Drive and Leuthold Drive and had a clear line-of-site view to the proposed mine site. Daytime L_{eq} noise levels were measured at 33 to 37 dBA and nighttime levels were projected at 30 to 35 dBA L_{eq}.

Site M7: Site M7 was located at the Tom Walyer residence in the Cleary Summit Subdivision. The monitoring location was near the garage facing the Steese Highway. Major noise sources in this area include traffic noise along the Steese Highway, local residential activities, dogs barking, along with wind and other atmospheric noise. Hourly L_{eq} noise levels ranged from 25 to 68 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 21 dBA to 24 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 32.2 dBA.

Site M8: Site M8 was located at the Brent LeValley residence in the Cleary Summit Subdivision. The monitoring location was near the garage facing the Steese Highway. Major noise sources in this area include traffic noise along the Steese Highway, local residential activities, dogs barking, along with wind and other atmospheric noise. Hourly L_{eq} noise levels ranged from 25 to 68 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 21 dBA to 24 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 32.2 dBA.. was located at the Tom Walyer residence in the Cleary Summit Subdivision. The noise monitoring system was installed at the northeast end of the property along Ridge Run Road. Major noise sources in this area are the same as given for M7, and include traffic noise along the Steese Highway, local residential activities, dogs barking and wind. Hourly L_{eq} noise levels ranged from 30 to 58 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 21 dBA to 24 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 32.2 dBAwas located at the Brent LeValley residence in the Cleary Summit Subdivision. was located at the Tom Walyer residence in the Cleary Summit Subdivision.was located at the Brent LeValley residence in the Cleary Summit Subdivision. The monitoring location was near the garage facing the Steese Highway. Major noise sources in this area include traffic noise along the Steese Highway, local residential activities, dogs barking, along with wind and other atmospheric noise. Hourly L_{eq} noise levels ranged from 25 to 68 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 21 dBA to 24 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 32.2 dBA.. was located at the Tom Walyer residence in the Cleary Summit Subdivision. The noise monitoring system was installed at the northeast end of the property along Ridge Run Road. Major noise sources in this area are the same as given for M7, and include traffic noise along the Steese Highway, local residential activities, dogs barking and wind. Hourly L_{eq} noise levels ranged from 30 to 58 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 21 dBA to 24 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 32.2 dBAwas located at the Brent LeValley residence in the Cleary Summit Subdivision. was located at the Tom Walyer residence in the Cleary Summit Subdivision. The noise monitoring system was installed at the northeast end of the property along Ridge Run Road. Major noise sources in this area are the same as given for M7, and include traffic noise along the Steese Highway, local residential activities, dogs barking and wind. Hourly L_{eq} noise levels ranged from 30 to 58 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 21 dBA to 24 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 32.2 dBA.

Site M9: Site M9 was located at the Mt. Aurora Fairbanks Creek Bed and Breakfast in the Skiland Subdivision. The system was installed on the deck on the southwest corner of the bed and breakfast overlooking Fairbanks Creek Road. Major noise sources in this area include traffic noise along the Steese Highway and Fairbanks Creek Road, local residential activities, dogs barking and wind. Hourly L_{eq} noise levels ranged from 32 to 52 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 27 dBA to 31 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 36.8 dBA.

Site M10: Site M10 was located at the Cleary Summit Bed and Breakfast, also in the Skiland Subdivision. The system was installed on the upper deck in the southwest corner overlooking Fairbanks Creek Road. Major noise sources in this area are the same as given for receiver M9 and include traffic noise along the Steese Highway and Fairbanks Creek Road, local residential activities, dogs barking and wind. Hourly L_{eq} noise levels ranged from 32 to 70 dBA, with the quieter noise levels being recorded at nighttime. The 70 dBA hourly L_{eq} was recorded during thunderstorms that went through the area during the noise monitoring session. Absolute minimum one-minute noise levels ranged from 26 dBA to 31 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 35 dBA.

Site M11: Site M11 was located at the Lance Parrish residence in the Skiland Subdivision. The monitoring location was inside the house near an open window in the northwest corner of the residence. Major noise sources in this area are the same as given for receivers M9 and M10 and include traffic noise along the Steese Highway and Fairbanks Creek Road, local residential activities, dogs barking and to a lesser extent, noise from wind. Hourly L_{eq} noise levels ranged from 32 to 50 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels were measured at 27 dBA (L_{99} and L_{90}) with average one-minute noise levels (L_{50}) of 34.2 dBA.

Site M12: Site M12 was located at the Mike Goulding residence in the Skiland Subdivision. The monitoring location was to the rear of a new building overlooking the Fairbanks Creek Road, along the western side of the property. Major noise sources in this area are the same as given for receivers M9 through M11 and include traffic noise along the Steese Highway and Fairbanks Creek Road, local residential activities, dogs barking and wind. During the first several hours of noise monitoring at this location, wind was causing added noise from loose construction paper located on the new structure. The data shows that the construction paper was secured around 7 pm, however, the wind noise continued resulting in slightly higher average noise levels. Hourly L_{eq} noise levels ranged from 42 to 58 dBA, with the quieter noise levels being recorded at nighttime. Absolute minimum one-minute noise levels ranged from 37 dBA to 41 dBA (L_{99} to L_{90}) with average one-minute noise levels (L_{50}) of 45.9 dBA. On several occasions, the minimum noise levels at this location equaled the 25 to 30 dBA range noted at other locations in the immediate area.

Site M13: Site M13 was near the Skiland lodge and chairlift. This location is considered a commercial land use. Hourly L_{eq} noise levels ranged from 30 to 42 dBA, with absolute minimum one-minute noise levels of under 30 dBA. The location is partially shielded from traffic noise on Fairbanks Creek Road and therefore has slightly lower noise levels than those monitoring locations closer to the road.

3.16 SOCIOECONOMICS

Mining Public Consent (2000a) surveyed existing socioeconomic conditions in the greater FNSB as well as in the area of the proposed True North project. The information below is based on that survey.

3.16.1 POPULATION AND DEMOGRAPHICS

Population

The current population of the FNSB is 83,928 (ADOL, 1999). It ranks as the second largest population center in Alaska, after Anchorage. The population of the FNSB has been growing at an annual rate of approximately 1 percent since 1990. Growth has accelerated slightly in recent years, with the population growing at an annual rate of 1.3 percent since 1996. This population growth has been occurring despite a significant decline in the military population of the FNSB. In fact, the military population (uniformed military and their dependents) of the FNSB has dropped by about 2,500 (14 percent) as a result of base down-sizing since 1990. In 1998, uniformed military and their dependents accounted for 19 percent of the FNSB population, down from 24 percent in 1990. Table 3.16-1 presents the FNSB populations for 1990, and 1996 to 1998 based on Alaska Department of Labor (ADOL) figures.

Table 3.16-1
Fairbanks North Star Borough Population 1990, 1996 to 1998

	1990	1996	1997	1998
Fairbanks North Star Borough	77,720	81,889	82,110	83,928
Eielson census subarea	5,266	5,621	4,462	4,962
Fairbanks North Star census subarea	72,454	76,268	77,648	78,966
College CDP*	11,249	11,875	11,587	12,407
Ester CDP	147	218	235	236
Fairbanks City	30,843	31,434	31,773	31,601
Fox CDP	275	309	320	326
Harding Lake CDP	27	29	28	30
Moose Creek CDP	610	631	677	677
North Pole city	1,456	1,504	1,616	1,619
Pleasant Valley CDP	401	558	550	542
Salcha CDP	354	376	369	390
Two Rivers CDP	453	630	622	612
Rest of Fairbanks census subarea	26,639	28,704	29,871	30,526

* CDP-Census Designated Place
Source: ADOL (1999)

The fastest growing areas of the borough include some of the more rural areas. The Pleasant Valley and Two Rivers areas have both grown 35 percent since 1990, and Fox has grown by 18 percent. In comparison, the population within the Fairbanks city limits has increased by only 2.5 percent. The North Pole and College areas have grown by 11 percent and 10 percent, respectively, since 1990.

Demographics

In 1998, the FNSB population was 53 percent male, 47 percent female (a reflection of the significant military presence in the area), the same proportions as in 1990. The borough's racial composition included 82 percent Caucasian, 8 percent African American, 7 percent Alaska Native, and 3 percent Asian/Pacific Islander. Since 1990, these proportions have changed only slightly, with a 1.3 percent decrease in the proportion of Caucasians in the local population and small increases in the proportion of minority groups, ranging from 0.2 percent (Asian/Pacific Islanders) to 0.7 percent (African Americans) (ADOL, 1999).

According to ADOL estimates, the average age of Fairbanks residents is 30.1 years, slightly below the Alaska statewide average of 32.4 years. Following a statewide trend, the average age of Fairbanks residents is increasing, rising from 27.5 years in 1990. Statewide, the average age increased from 29.3 in 1990 to 32.4 in 1998. This aging of the population in the Fairbanks area is primarily due to military down-sizing in the borough.

Military cut-backs are also partly responsible for the proportional decline in percentage of children in the population. In 1990, 11 percent of the population was composed on children age 4 and under. By 1998, that percentage had dropped to 9 percent (and the total number of children in this age group had declined by 635 – or 8 percent).

Table 3.16-2
Fairbanks North Star Borough Race/Ethnic Composition 1990 and 1998

1990 U.S. Census				
Total Population (1990)	77,720		African American	5,618
Male	41,506		Asian/Pac Islands	2,047
Female	36,214		Caucasian	64,672
Native	5,330			
% Native	6.9%		Hispanic Origin*	2,889
Non-Native	72,390			
1998 Alaska Department of Labor				
Total Population (1998)	83,928		African American	6,616
Male	44,142		Asian/Pac Islands	2,408
Female	39,786		Caucasian	68,826
Native	6,078			
% Native	7.2%		Hispanic Origin*	3,790
Non-Native	77,850			

*Residents of Hispanic origin may be of any race.

Source: ADOL (1999)

Table 3.16-3

Fairbanks North Star Borough Population by Age and Male/Female 1990 and 1998

	July 1, 1998				April 1, 1990		
Age	Total	Male	Female		Total	Male	Female
0-4	7,655	3,891	3,764		8,290	4,269	4,021
5-9	7,849	3,986	3,863		7,362	3,818	3,544
10-14	7,426	3,858	3,568		5,886	3,104	2,782
15-19	6,219	3,331	2,888		5,363	2,918	2,445
20-24	6,025	3,220	2,805		7,762	4,548	3,214
25-29	6,673	3,714	2,959		8,464	4,489	3,975
30-34	7,311	3,862	3,449		8,533	4,347	4,186
35-39	7,933	4,107	3,826		7,741	4,190	3,551
40-44	7,670	3,902	3,768		5,987	3,299	2,688
45-49	6,499	3,566	2,933		3,878	2,104	1,774
50-54	4,398	2,441	1,957		2,524	1,404	1,120
55-59	2,951	1,573	1,378		1,931	1,009	922
60-64	1,799	995	804		1,494	808	686
65-69	1,324	693	631		1,083	531	552
70-74	994	489	505		681	328	353
75-79	650	296	354		400	204	196
80-84	354	142	212		204	79	125
85+	198	76	122		137	52	85
18+	57,433	30,510	26,923		53,313	28,802	24,511
16+	59,759	31,751	28,008		55,212	29,799	25,413
65+	3,520	1,696	1,824		2,505	1,194	1,311
Median	30.1	30.1	30.1		27.5	27.3	27.6
Total	83,928	44,142	39,786		77,720	41,501	36,219

Source: ADOL (1999)

3.16.2 Income and Employment

Household Income

According to the U.S. Department of Housing and Urban Development (HUD), the median family income in the FNSB for 1999 was $49,200, about 3 percent above the national median of $47,800. The FNSB family income levels are the same as other urban Alaska areas, including Anchorage at $49,200, but well above the poorer rural areas, such as Bethel at $29,900. According to HUD data, median family income in the FNSB has increased slowly, rising from $46,200 in 1996 to $47,000 in 1997 and to $49,200 in 1998, where it remains today. In 1990, the median family income in the FNSB was $41,729.

Table 3.16-4

FNSB Household Income and Community Poverty Levels 1990 US Census

Families with Household Income:			
Less than $10,000	1,031	$60,000 - $74,999	2,435
$10,000 - $19,999	2,694	$75,000 - $99,999	2,102
$20,000 - $29,999	2,715	$100,000 - $125,000	653
$30,000 - $39,999	2,850	$125,000 - $149,000	225
$40,000 - $49,999	2,221	Over $150,000	270
$50,000 - $59,999	2,092		

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Personal Income

In 1997, according to the U.S. Department of Commerce, Bureau of Economic Analysis, the FNSB had a per capita personal income of $21,417, 86 percent of the state average of $24,969, and 85 percent of the national average of $25,288. Since 1990 FNSB per capita income has grown at a nominal annual rate of 3.2 percent, rising from $17,483 in 1990.

Per capita income growth for the FNSB has just been keeping pace with inflation. Between 1990 and 1997, Alaska's inflation rate averaged 3 percent, based on the Anchorage Consumer Price Index. This suggests that there was no real per capita income growth in the FNSB between 1990 and 1997.

Table 3.16-5
Fairbanks North Star Borough Annual Per Capita Personal Income 1990, 1995 to 1997

	1990		1995	1996	1997
Fairbanks North Star Borough	$17,483		$20,660	$20,643	$21,417
Alaska Statewide Average	$21,191		23,971	24,310	24,969
US Average			$23,059	$24,164	$25,288

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

In 1997, the FNSB had total personal income of $1.8 billion, ranking the borough second in the state and accounting for 11.9 percent of the Alaska total. In 1990, the total personal income for the FNSB was $1.4 billion.

Total personal income includes the earnings (wages and salaries, other labor income, and proprietor's income); dividends, interest, and rent; and transfer payments received by the residents of FNSB (including Permanent Fund Dividends). In 1997, earnings were 66 percent of total personal income (compared with 84 percent in 1990); dividends, interest, and rent were 13 percent (compared with 15 percent in 1990); and transfer payments were 21 percent (compared with 20 percent in 1990).

Table 3.16-6

Fairbanks North Star Borough Annual Per Capita Personal Income 1990, 1995 to 1997

	1990	1995	1996	1997
Total Personal income (000s $)	$1,365,239	$1,732,519	$1,762,058	$1,808,724
Earnings by place of work	1,150,506	1,373,241	1,383,835	1,444,374
less: Personal cont. for social insurance	73,979	89,011	89,308	100,119
plus: Adjustment for residence	-114,832	-124,701	-140,300	-148,045
equals: Net earnings by place of residence	961,695	1,159,529	1,154,227	1,196,210
plus: Dividends, interest, and rent	177,692	249,119	259,823	239,495
plus: Transfer payments	225,852	323,871	348,008	373,019
Wage and salary disbursements	966,080	1,146,195	1,158,819	1,213,284
Other labor income	82,261	109,763	107,545	107,817
Proprietors' income	102,165	117,283	117,471	123,273
Private earnings	609,745	763,491	766,900	806,561
Government and government enterprises	540,354	607,089	615,179	635,461

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Earnings by Industry

Earnings of persons employed in the FNSB increased from $1.2 billion in 1990 to $1.4 billion in 1997. In terms of earnings, the largest industries in 1997 were services, 19.7 percent of earnings; state and local government, 18.7 percent; and military, 15.1 percent. In 1990, the largest industries were state and local government, 22.0 percent of earnings; services, 19 percent; and military, 16 percent.

Since 1990, private sector earnings have increased by 32 percent while government sector earnings have increased by 18 percent. In the private sector, services have accounted for the lion’s share of the total earnings increase since 1990 ($71 million – a 33 percent jump). Proportionately, the mining sector (including oil and gas extraction) has grown the fastest, with earnings more than quadrupling from $11 million in 1990 to $49 million in 1997. Earnings for workers in the metal mining sector jumped from $5 million to $20 million, mostly due to the start-up of the Fort Knox Mine.

A 30 percent increase in the transportation sector includes a 56 percent increase in air transportation earnings. Much of the economic growth experienced in Fairbanks over the last eight years stems from expansion of the tourism industry and maturation of the local service and supply sectors. For example, in the tourism industry, earnings in the hotel/lodging sector increased from $7 million to $15 million. In the support sector, earnings in general merchandise stores increased from $9 million to $17 million. Following a statewide trend, earnings in the health care sector increased from $52 million to $80 million, a 52 percent increase.

Table 3.16-7

Fairbanks North Star Borough Earnings by Industry 1990, 1995 to 1997

	1990	1995	1996	1997
Private earnings ($000)	609,745	763,491	766,900	806,561
Agricultural serv., forestry & fishing	4,325	3,935	3,878	3,525
Mining	11,592	42,142	40,480	48,917
Construction	100,457	107,142	100,992	104,290
Manufacturing	26,593	30,016	28,210	31,563
Durable goods	9,905	10,713	9,756	11,183
Non-durable goods	16,688	19,303	18,454	20,380
Transportation and public utilities	89,854	103,537	106,377	118,085
Wholesale trade	26,854	29,176	28,918	31,243
Socioeconomic consulting	8,120	17,846	92,107	188,962
Retail trade	111,914	141,430	143,960	149,194
Finance, insurance, and real estate	24,483	30,809	31,911	34,965
Services	213,673	275,304	282,174	284,779
Government	540,354	607,089	615,179	635,461
Federal, civilian	102,131	115,033	118,662	146,241
Military	185,154	204,482	221,804	218,500
State and local	253,069	287,574	274,713	270,720
State	150,246	167,484	163,333	153,925
Local	102,823	120,090	111,380	116,795

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Employment

In 1998, the FNSB economy included an annual average of 32,550 non-agricultural wage and salary jobs, 19 percent more than the 27,250 wage and salary jobs in 1990. Since 1990, FNSB employment has increased at an annual rate of 2.2 percent. Over the last eight years, FNSB employment has increased by 5,300 jobs, led by growth in the service sector (1,850 new jobs) and the trade sector (1,000 new jobs). Proportionately, growth in the mining sector (including both metal mining and some oil industry employment) has out-paced all other industries, adding 750 new jobs – a 600 percent increase.

The most recent available unemployment statistics indicate unemployment in the FNSB remains relatively low, matching statewide and national trends. Unemployment during the summer of 1998 was 4 percent (during August). Summer unemployment in the borough has been trending down for at least the last seven years. In August of 1992, unemployment stood at 7.4 percent. The rate dropped to 6.4 percent in 1993, 6.2 percent in 1994 and 5.6 percent in 1995. The rate increased slightly in 1996 before continuing the downward trend.

Table 3.16-8
Fairbanks North Star Borough Employment (Annual Average) Non-Agricultural Wage and Salary Employment 1990, 1996 to 1998

	1990	1996	1997	1998
Total	27,250	31,850	32,050	32,550
Mining	150	950	1,150	900
Construction	1,550	1,800	1,650	1,750
Manufacturing	600	500	550	600
Transportation	2,000	2,350	2,500	2,950
Trade	5,950	7,000	6,800	6,950
Finance	800	1,000	1,050	1,100
Services	6,200	7,800	7,900	8,050
Federal	3,100	3,200	3,350	3,300
State	4,200	4,350	4,200	4,200
Local	2,700	2,950	2,950	2,800

Source: *Alaska Economic Trends*, various issues. Alaska Department of Labor, Research and Analysis Section.

Like most of Alaska, Fairbanks has a seasonal component in its economy. Winter unemployment rates are typically double summer rates. As the tourism industry grows and becomes a more important part of the local economy, the economy's seasonality is likely to increase. Other activities also add to economic seasonality, including construction and regional mineral exploration. The University of Alaska school year tends to offset some of the economy's seasonality.

Table 3.16-9

Fairbanks North Star Borough Unemployment Rates

August and February 1992 to 1999

	1992	1993	1994	1995	1996	1997	1998	1999
February	13.0%	10.4%	10.8%	9.7%	9.8%	10.6%	7.7%	8.2%
August	7.4%	6.4%	6.2%	5.6%	5.9%	5.5%	4.3%	na

Source: Alaska Department of Labor, Research and Analysis Section.

Average Wages

In 1997, non-agricultural wages and salaries averaged $2,520 per month, or $30,240 annually, in the FNSB. The mining industry, including oil and gas extraction, is by far the highest paying sector in the economy. The mining industry's average wage of $56,280 per year is 86 percent above the FNSB average of $30,240. At the low end of the range is the trade sector ($19,164 a year), a sector that includes a large number of part-time jobs (in addition to low-paying hourly jobs).

Table 3.16-10

Fairbanks North Star Borough Unemployment Rates August 1998 and February 1999

	August 1998	February 1999
Fairbanks North Star Borough	4.3%	8.2%
Alaska Statewide Average	4.5%	8.1%
US Average	4.5%	4.7%

Source: *Alaska Economic Trends*, various issues. Alaska Department of Labor, Research and Analysis Section.

Table 3.16-11

Fairbanks North Star Borough Average Wages Non-Agricultural

Wage and Salary Employment 1997

1997	Average Monthly Earnings	Average Annual Earnings
Mining	$4,690	$56,280
Construction	3,581	42,972
Manufacturing	3,161	37,932
T.C.U.*	2,963	35,556
Trade	1,597	19,164
F.I.R.E.**	2,339	28,068
Services	2,079	24,948
Federal Government	3,289	39,468
State Government	2,715	32,580
Local Government	3,274	39,288
All Industries Average	$2,520	$30,240

*T.C.U.: Transportation, Communications and Utilities.

**F.I.R.E.: Finance Insurance and Real Estate.

Source: Employment and Earnings Report, 1997, Alaska Department of Labor, 1998.

In real dollars (inflation-adjusted), average wages have declined slightly over the past five years. After adjusting for inflation, the average annual salary in Fairbanks declined by 9 percent between 1992 (when the average annual wage was $31,100 in 1997 dollars) and 1997. This does not mean that the typical wage earner in Fairbanks has seen his wages decline. It indicates that jobs being added to the local economy have been lower-paying jobs and that more of the new jobs are part-time. This downward trend in wages is typical of maturing economies and is also a side-affect of tourism industry growth.

Table 3.16-12

Fairbanks North Star Borough Average Wages Non-Agricultural Wage and Salary Employment 1997

	Ave. Monthly Wage	Real Ave. Wages* (1997$)	Ave. Annual Wage	Real Ave. Wage (1997$)
1992	$2,441	$2,757	$29,292	$33,085
1993	2,433	2,667	29,196	32,003
1994	2,430	2,607	29,160	31,288
1995	2,480	2,586	29,760	31,035
1996	2,433	2,469	29,196	29,626
1997	2,520	2,520	30,240	30,240

*Adjusted using the Anchorage Consumer Price Index – All Items.

Source: Average monthly wage from the Alaska Department of Labor. Real average wage calculated by the McDowell Group.

3.16.3 ECONOMIC BASE

Fairbanks Economy

Key basic industries in the Fairbanks economy include the military, University of Alaska, the oil industry, tourism, mining, and federal and state governments. In addition, Fairbanks is interior Alaska's regional service and supply center. Following are brief discussions of the borough's basic industries:

Military: The military employs approximately 4,500 uniformed personnel and 1,250 civilians at Fort Wainwright. Another 3,000 uniformed personnel are stationed at Eielson Air Force Base along with 1,000 civilian employees. In fiscal year 1997, military payroll in the Fairbanks area totaled $312 million, approximately 17 percent of total personal income in the borough. Non-personnel military expenditures totaled $71 million in FY 1997.i

University of Alaska: The University of Alaska Fairbanks employs approximately 2,600 full and part-time faculty, staff and support personnel in Fairbanks. Annual payroll totals $85 million. The University spends another $23 million annually in Fairbanks on goods and services (McDowell Group, 1998). Other than the military, the university is the single largest employer in Fairbanks.

Oil industry: The oil industry plays a diverse and important role in the FNSB economy. Alyeska Pipeline Service Company and Williams Petroleum are large employers in the borough. Fairbanks is also home to a number of North Slope workers. The oil industry's indirect economic impact on the community includes tens of millions of dollars that flow to Fairbanks from the State of Alaska General Fund. North Slope oil revenues account for about 80 percent of State General Fund revenues. Further, oil and gas industry property taxes paid to the FNSB total over $4 million annually.

A 1995 study found that “as much as one-third of the overall economic activity in the region was based on oil production” (ISER, 1995). In 1995, companies producing, transporting and refining oil employed 495 workers in Fairbanks who earned $38 million in payroll. Oil-related employment and payroll in Fairbanks have increased since 1995 as a result of expansion of Alyeska’s presence in the community.

Mining: Fairbanks’ mining industry includes the Fort Knox Mine, a large-scale gold mine employing 260 workers. Fort Knox employees earned approximately $13.3 million in payroll in 1998. In addition to this payroll, the mine spent another $32 million in Fairbanks on goods and services in support of its operations (Information Insights and the McDowell Group, 1999). The mine is the fifth-largest private sector employer in Fairbanks.

The mining industry is also a key contributor to local government services in the borough. With a 1998 assessed value of $253 million, the Fort Knox Mine paid $3,916,845 in property taxes out of total 1997 borough property tax revenues of $48,313,435. This represents approximately 8 percent of total FNSB property tax revenues. The Fort Knox Mine is among the single largest sources of property tax revenues for the borough, second only to the Trans-Alaska Pipeline.

Fairbanks is also the service and supply center for interior Alaska’s mining industry, which includes significant placer mining activity and hard-rock mineral exploration. The successful development of Fort Knox has played a key role in the acceleration of mining exploration in the Fairbanks area. In the eastern interior region, exploration spending totaled $30.3 million in 1997, according to State of Alaska data. Since 1994, exploration spending in the region has more than tripled. Exploration spending in 1998 in the eastern Interior is expected to top the 1997 total by several million dollars. Most of the exploration activity in the Interior is supported through Fairbanks.

Tourism: Little up-to-date data is available on Fairbanks’ tourism industry, however, the industry has certainly become an important component of the local economy. During the 1993-94 visitor year, 292,000 non-Alaskan visitors spent a total of $65 million in Fairbanks, including $58 million during the summer and $7 million during the winter. Since 1993-94, visitor traffic to Fairbanks has probably increased by 30 percent, pushing the annual total to approximately 380,000 visitors and pushing spending up to $85 million. Visitor industry employment data is not available.

Other Basic Industries: State and federal governments (in addition to the military) also play key roles in the FNSB economy. Including the University of Alaska, the State of Alaska employed 4,200 workers in Fairbanks in 1998. The Federal Government employed 3,300 workers, not counting active-duty military personnel. Tribal government activity is also important in the borough economy. In 1998, Tanana Chiefs Conference, an organization that provides social services and health care to the interior Alaska's Native population, employed 610 workers, mostly in the Fairbanks area.

3.16.4 FNSB Government Finances

The 7,400-square mile FNSB is a second class borough with a total 1998 assessed property valuation of $3,433 million (not including the pipeline valuation of $286 million). The borough levies an area-wide 13.775 mill property tax and an 8 percent accommodation tax. There is no borough sales tax.

The fiscal year 1998-99 approved budget for the FNSB was $81.7 million. Revenues included $48.2 million from the area-wide property tax, $15.0 million in state and federal government revenue, $5.5 million from charges for services and a variety of other revenues. The single largest borough expenditure was education. The borough budget includes $30.7 million for education, 38 percent of the total FNSB budget.

3.16.5 Community Facilities and Services

Housing

Availability of housing in Fairbanks, and new housing construction rates from 1997 to 1999, have been significantly affected by the increased economic activity in the region during this period.

Table 3.16-13

Fairbanks North Star Borough Budget FY97/98 and 98/99

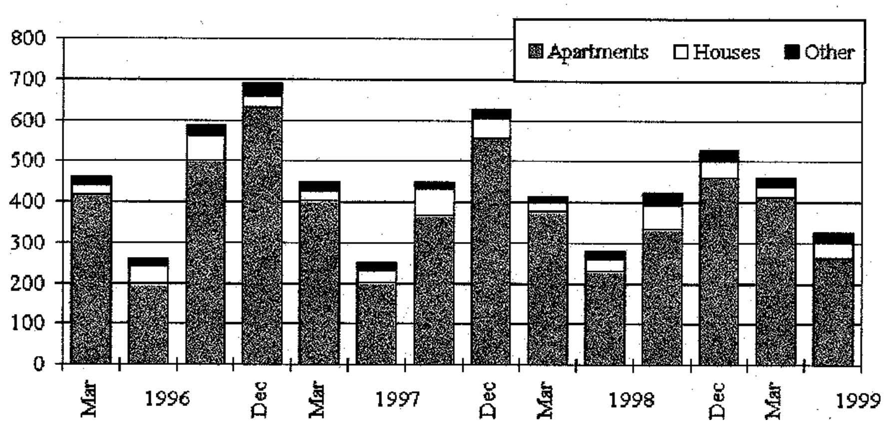
	FY97/98	FY 98/99
	Revised	Approved
Revenues ($000)		
Areawide Property tax	43,958	48,185
Non-Area Wide Property tax	1,166	1,129
Solid Waste Collection	2,632	2,782
Other Local taxes	603	602
Charges for Services	5,402	5,547
Interest earnings	2,501	2,703
Enhanced 911 Surcharge	335	356
State Debt Reimbursement	8,362	8,537
Other State and Federal Revenue	6,545	6,446
Other Local Revenue	55	55
Enterprise funds	1,605	1,795
Intragovernmental Revenue	2,788	2,961
Contribution from Fund balance	2,495	1,246
Less:		
Revenue Allocated to Service Areas	(440)	(423)
Contribution to Fund Balance	(133)	(242)
Expenditures (By Function - $000)		
Assembly	1,029	1,109
Mayor	785	731
Law	585	588
Assessing	1,574	1,636
Community Planning	1,135	1,160
Direct Services	2,334	2,643
Finance and Computer Services	6,759	7,031
General Services	928	977
Land Management	860	908
Library Services	2,613	2,841
Parks and Recreation	4,163	4,298
Public Works	8,509	8,741
Transportation	2,710	2,953
Capital Budget	5,028	2,547
Debt Service	10,801	12,219
Education	27,680	30,691
Non-Departmental	385	607
Total Expenditures	**77,878**	**81,680**

Table 3.16-14 shows FNSB's total rental housing units available during 1996-1999. The total number of efficiency apartment rental housing units available in June 1999 decreased by 50% from June 1998. Similarly, the total number of one-bedroom apartment rental units available in June 1999 decreased by 14% from June 1998. The total number of 2 bedroom apartments available in June 1998 increased by 52% by June 1999. The total number of 2 bedroom houses available in June 1999 increased by 86% from June 1998. Overall, total number of rentals (including apartments, houses, and mobile homes and cabins) increased by 16% from June 1998 to June 1999. These figures reflect the seasonal nature of the Fairbanks area's rental housing demand, and the continuing demand for smaller units of rental housing in the FNSB.

The percentage of vacant apartment/multiplex units (only) during 1995-1999 in the FNSB are shown in Table 3.16-15. The apartment rental vacancy rate in March 1999 was 7.5%, up from 6.9% in March 1998. This is reflected in the increase in the number of rental units available, from 413 in March 1998 to 463 available during the same period in 1999.

Table 3.16-14
FNSB Total Rental Housing Units Available 1996-1999

	Apartments				Houses				Mobile		Total
	Eff.	1 BR	2 BR	3+BR	1 BR	2 BR	3 BR	4+BR	Homes	Cabins	Rentals
1996											
March	52	159	176	29	5	7	12	1	16	6	463
June	27	82	66	25	11	12	15	3	8	11	260
September	36	236	189	40	16	24	17	4	13	15	590
December	52	283	260	35	5	9	13	2	10	22	691
1997											
March	51	187	139	26	2	10	8	4	12	9	448
June	19	71	82	29	5	7	13	4	13	9	252
September	37	137	162	32	10	21	27	8	7	9	450
December	42	190	263	62	5	20	18	6	10	12	628
1998											
March	47	109	187	34	2	7	14	1	4	8	413
June	26	85	89	31	4	7	10	7	11	11	281
September	42	109	151	34	10	18	17	11	10	22	424
December	48	166	199	50	7	11	15	4	11	16	527
1999											
March	45	179	156	34	4	10	7	5	12	11	463
June	13	73	135	43	4	13	16	4	11	14	326
% Change '98-99 June	**-50%**	**-14%**	**52%**	**39%**	**0%**	**86%**	**60%**	**-43%**	**0%**	**27%**	**16%**



Source: Community Research Center Rental Surveys, 1996-99, including most major apartment complexes and Fairbanks Daily News-Miner advertisements during the week surrounding the 19th of March, June, September and December.

The average monthly rents for all types of available housing units in the FNSB during 1996-1999 are summarized in Table 3.16-16. The average monthly rent for an efficiency apartment increased by 9% from June 1998 to June 1999. The average monthly rent for a one-bedroom apartment decreased by 2% from June 1998 to June 1999. The average monthly rent for both two and three bedroom rental homes decreased by an average of 5% from June 1998 to June 1999. The average monthly rent for a mobile home increased by 11% from June 1998 to June 1999. Overall, total monthly rents for apartments, houses, and mobile homes and cabins, decreased by 16% from June 1998 to June 1999.

Residential housing sales (including one, two, three, four and five+ bedroom homes) within the FNSB from 1997 to 1999 (through second quarter) are summarized in Table 3.16-17. The price of a one bedroom home rose by 19% during this time; however, the number of homes sold decreased by 2% during this same period. The price of a two-bedroom home increased by 10% and the number of units sold increased by 15% during this same period. The total number of all types of homes that sold in the FNSB increased by 22% during this period of time; however, the average selling price during this period increased by 6%. The verage selling price for homes sold in 1997 was $116,963. The average selling price for all numbers of homes sold in 1998 was $124,527. The rise in price of these sales figures may be due to appreciation and market demand.

Table 3.16-15
FNSB Apartment/Multiplex Vacancy Rates 1995-1999

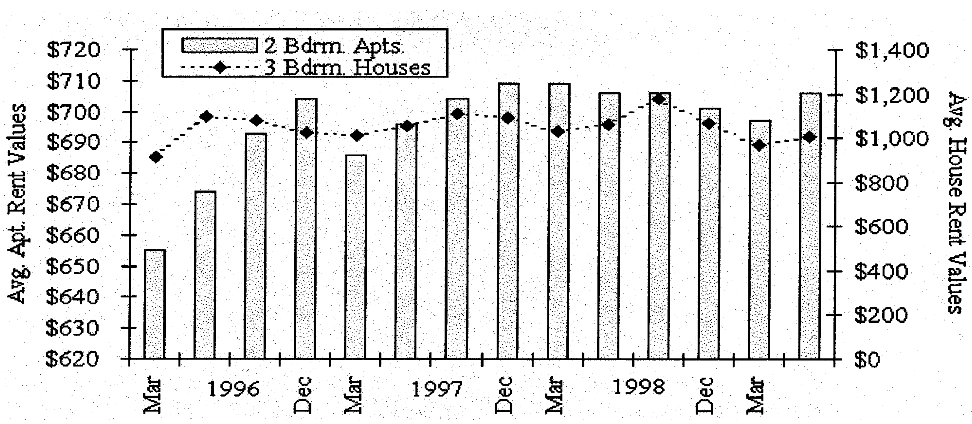
	1995	1996	1997	1998	1999
	Percent Vacant				
March	8.2	7.0	8.7	6.9	7.5
June	4.8	2.8	2.9	3.7	3.2
September	4.3	7.2	6.1	5.7	
December	8.3	12.0	10.8	8.0	

Table 3.16-18 shows the American Chamber of Commerce Researchers Association (ACCRA) cost of living Index for selected cities in western and southern United States. The ACCRA cost of living index is based on a sample of goods and services purchased by a typical mid-management family.

Table 3.16-19 shows the average percent change in Anchorage in the consumer price index during 1993 through 1998. The index is not available for Fairbanks; however, the semi-annual Consumer Price Index for all Urban Consumers (CPI-U) for Anchorage in the second half of 1998 was 1.1% higher than the second half of 1997, and 2.0% higher than the first half of 1997.

Table 3.16-16
FNSB Average Monthly Rents for Available Housing Units 1996-1999

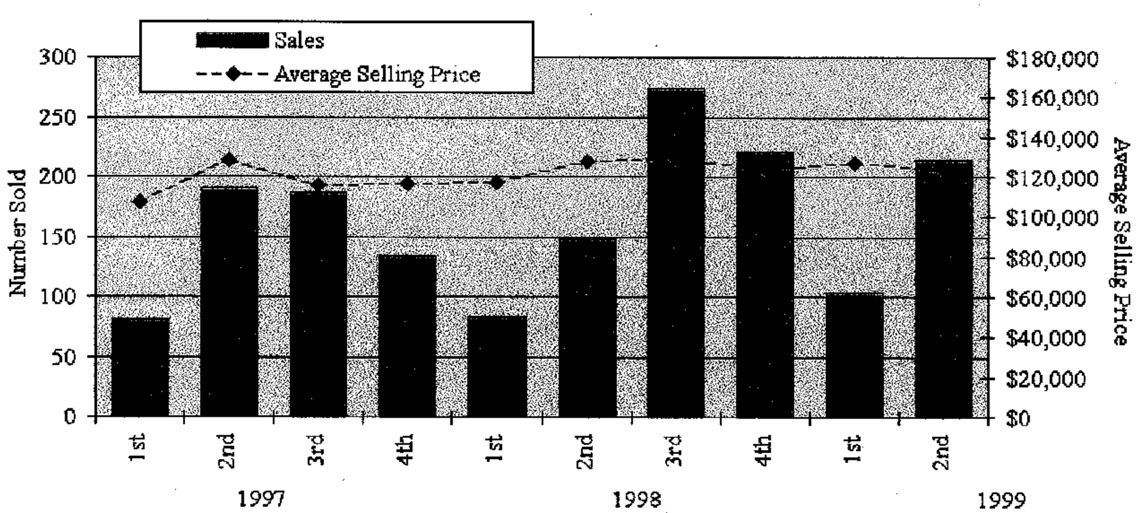
	Apartments				Houses				Mobile	
	Eff.	1 BR	2 BR	3+ BR	1 BR	2 BR	3 BR	4+ BR	Homes	Cabins
1996										
March	$417	$512	$655	$812	$537	$775	$917	$1,500	$678	$320
June	$393	$517	$674	$918	$619	$857	$1,098	$1,308	$670	$337
September	$430	$517	$693	$879	$648	$810	$1,081	$1,192	$650	$376
December	$412	$536	$704	$850	$588	$701	$1,028	$1,300	$632	$400
1997										
March	$442	$539	$686	$946	$562	$779	$1,011	$1,000	$671	$384
June	$434	$534	$696	$940	$728	$846	$1,055	$1,211	$622	$426
September	$431	$550	$704	$882	$586	$842	$1,113	$1,211	$631	$424
December	$456	$563	$709	$890	$579	$804	$1,095	$1,250	$616	$460
1998										
March	$477	$540	$709	$849	$562	$849	$1,031	$950	$598	$341
June	$404	$556	$706	$921	$692	$1,007	$1,065	$1,274	$622	$406
September	$496	$559	$706	$950	$579	$903	$1,179	$1,240	$645	$399
December	$439	$532	$701	$975	$639	$854	$1,070	$1,162	$567	$458
1999										
March	$409	$552	$697	$890	$627	$799	$973	$1,270	$632	$451
June	$442	$547	$706	$959	$712	$967	$1,005	$1,343	$691	$343
% Change '98-99 June	**9%**	**-2%**	**0%**	**4%**	**3%**	**-4%**	**-6%**	**5%**	**11%**	**-16%**



Source: Community Research Center Rental Surveys, 1996-99, including most major apartment complexes and Fairbanks Daily News-Miner advertisements during the week surrounding the 19th of March, June, September and December. Note: Rental amounts may include some or all utilities.

Table 3.16-17
FNSB Residential Housing Sales* 1997-1999

Quarter	1 Bedroom		2 Bedroom		3 Bedroom		4 Bedroom		5+ Bedroom		Total	
	#	Price	#	Price	#	Price	#	Price	#	Price	#Sold	Avg.Price
1997												
1st Qtr.	8	$46,312	16	$61,719	41	$126,550	15	$133,977	1	$112,000	81	$107,015
2nd Qtr.	11	$49,782	38	$91,468	95	$136,886	37	$161,076	10	$159,030	191	$128,679
3rd Qtr.	16	$54,562	53	$83,149	77	$130,269	35	$150,207	6	$180,030	187	$115,765
4th Qtr.	11	$59,341	28	$88,609	65	$131,740	24	$146,440	6	$155,833	134	$116,393
1997 Total	**46**	**$209,997**	**135**	**$324,945**	**278**	**$525,445**	**111**	**$591,700**	**23**	**$606,893**	**593**	**$116,963**
1998												
1st Qtr.	4	$54,700	16	$81,175	49	$121,786	7	$182,986	7	$133,557	83	$116,878
2nd Qtr.	9	$66,556	40	$85,488	70	$141,150	21	$170,516	8	$176,093	148	$127,626
3rd Qtr.^	16	$65,594	56	$95,562	132	$130,776	58	$173,012	12	$146,883	274	$129,419
4th Qtr.	16	$62,628	43	$94,708	106	$126,112	50	$161,377	6	$155,583	221	$124,184
1998 Total	**45**	**$249,478**	**155**	**$356,933**	**357**	**$519,824**	**136**	**$687,891**	**33**	**$612,116**	**726**	**$124,527**
1999												
1st Qtr.	5	$54,300	28	$90,343	47	$132,853	16	$175,609	8	$169,238	104	$127,008
2nd Qtr.	12	$81,782	54	$87,115	101	$131,574	40	$157,750	7	$157,143	214	$123,292
% Chg. '97-98	**-2%**	**19%**	**15%**	**10%**	**28%**	**-1%**	**23%**	**16%**	**43%**	**1%**	**22%**	**6%**



Source: Greater Fairbanks Board of Realtors and Alaska/Multiple Listing Service, Inc., personal and computer printout communications 1997-1999. Data maintained by the Board or its MLS may not reflect all real estate activity in the market, and neither the Board nor its MLS guarantees or is in any way responsible for accuracy of the data.

* Does not include houses without bedrooms.

Table 3.16-18
ACCRA Cost of Living Index for Selected Cities, 1st Qtr. 1999

City	All Items	Grocery Items	Housing	Utilities	Transpor-tation	Health Care	Msc. Goods & Services
	100%	16%	28%	8%	10%	5%	33%
West:							
Fairbanks, AK	**122.0**	**113.5**	**127.2**	**131.1**	**116.7**	**160.7**	**115.1**
Anchorage, AK	121.6	122.8	129.9	90.1	112.5	164.8	117.9
Kodiak, AK	142.0	145.8	146.4	171.8	127.4	159.5	131.0
Phoenix, AZ	101.9	102.0	99.0	103.1	112.2	112.6	99.2
Bakersfield, CA	103.6	116.4	90.2	120.7	114.8	109.5	100.3
Denver, CO	107.9	110.8	121.4	86.1	110.6	114.2	98.7
Boise, ID	97.5	100.5	97.9	75.2	100.7	114.6	97.6
Billings, MT	99.8	104.2	100.0	88.8	100.4	104.2	99.4
Santa Fe, NM	113.6	104.2	143.1	84.4	108.4	108.4	102.6
Portland, OR	111.7	107.0	123.3	80.9	120.4	120.5	107.7
Spokane, WA	105.3	102.9	113.4	65.1	102.6	120.8	107.9
Yakima, WA	106.1	105.5	116.4	77.9	100.7	134.1	102.0
Cheyenne, WY	98.7	106.8	97.0	80.9	96.2	96.1	101.6
South:							
Sarasota, FL	104.7	97.3	113.5	98.8	102.2	100.7	103.6
Atlanta, GA	103.3	103.3	102.9	102.3	101.5	118.5	102.0
Lafayette, LA	98.8	92.3	104.8	86.9	102.2	85.8	100.7
Kennett, MO	84.9	94.3	71.4	83.0	79.6	95.7	92.2
Tulsa, OK	96.4	94.9	90.4	88.4	94.9	97.9	104.3
Memphis, TN	92.3	94.9	90.1	83.2	99.2	94.4	92.7
Dallas, TX	100.4	98.5	95.2	101.8	105.1	109.6	102.5
North Central:							
Indianapolis, IN	96.0	100.7	88.8	98.7	93.8	95.4	100.0
Minneapolis, MN	103.5	98.1	96.0	107.1	116.9	115.3	105.8
Green Bay, WI	97.0	94.4	99.4	82.3	102.8	101.7	97.3
Northeast:							
New York, NY	232.1	150.2	455.6	163.2	125.4	187.0	137.9
Philadelphia, PA	120.5	109.2	139.3	144.2	120.4	99.2	107.6
Montpelier, VT	102.2	104.6	94.0	149.1	104.5	99.4	96.3
Richmond, VA	105.6	98.4	107.5	126.3	106.1	100.9	103.0
Avg. of 309 Urban Areas	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE: ACCRA (American Chamber of Commerce Researchers Association), "ACCRA Cost of Living Index," First Quarter 1999.

Table 3.16-19
Consumer Price Index, Anchorage, Alaska 1993-1998

	1993	1994	1995	1996	1997	1998	% Change 1997-98
January – June Average	131.5	134.3	138.2	141.8	144.1	146.7	1.8%
July – Dec. Average	132.8	135.8	139.5	143.7	145.4	147.0	1.1%
Annual Average	132.2	135.1	138.9	142.8	144.8	146.9	1.5%
% Change from Previous Year	3.1%	2.2%	2.8%	2.8%	1.4%	1.5%	

SOURCE: U.S. Department of Labor Statistics, "Consumer Price Indexes Pacific Cities and U.S. City Average", 1993- 1998.
NOTE: 1982-1984=100.1
*For All Urban Consumers.

Health and Social Services

Health and social services in the FNSB are provided by a combination of private, public and non-profit entities. As specifically noted in this section, some itinerant care is provided in outlying communities, but most residents across the borough travel to Fairbanks as needed for a full range of generalized acute and non-acute health care. Patients in need of highly specialized care are transported to centers in Anchorage or the Lower 48.

Full-Service Hospitals -- Fairbanks Memorial Hospital (FMH) is owned by the Greater Fairbanks Community Hospital Foundation and managed by Banner Health Systems, a non-profit agency headquartered in North Dakota. FMH has 135 beds and provides a full range of acute and non-acute care including obstetrics, pediatrics, surgery, cardiac care, orthopedics, radiology, emergency treatment, occupational therapy, and laboratory services. In recent years the hospital's occupancy rate has averaged 55 to 60%. A new radiation therapy treatment center will open in spring 2000 and will be out-patient only and won't impact occupancy rate.

Bassett Army Hospital is located on the Ft. Wainwright Army Base on the eastern boundary of the city of Fairbanks. It serves Ft. Wainwright Army Base and Eielson Air Force Base residents, as well as veterans residing throughout the FNSB with both in-patient and outpatient services.

Public Health Care -- Programs at the Fairbanks Regional Public Health Center (FRPHC) are funded by the state and include infant wellness clinics, immunizations, family planning clinics, and sexually transmitted disease clinics. It is staffed by public health nurses who also travel to and provide services in surrounding communities. Services to children are free and adult services are provided at nominal fees. The City of Fairbanks is responsible for building maintenance.

The Interior Neighborhood Health Clinic (INHC) is a non-profit agency that is publicly supported by state and federal government funds. Physicians and mid-level practitioners and nurses provide clinic services on a sliding-scale fee schedule.

Chief Andrew Isaac Health Center (CAIHC) is funded by the Indian Health Service and managed by Tanana Chiefs Conference (TCC), the non-profit regional Native corporation for the Interior. Free health care and pharmaceutical services are provided to Alaska residents of Native heritage. TCC also provides dental services, an eye clinic and community health aide services.

Sliding scale fee based mental health counseling, as well as residential services for the chronically mentally ill, are provided at the Fairbanks Community Mental Health Center. This is a non-profit agency that is funded largely by state and federal grants.

Long Term Care Facilities -- Both the Fairbanks Pioneers Home (owned and operated by the State of Alaska) and Denali Center (owned by the Greater Fairbanks Community Hospital Foundation) provide long term care for eligible Interior Alaska residents. Several privately owned residential long-term care facilities are operated within Fairbanks as well.

Other non-profit entities that provide counseling and other social services for area residents include: Access Alaska, Alaska Crippled Children and Adults, Fairbanks Counseling and Adoption, Fairbanks Crisis Line, Fairbanks Resource Agency, Hospice of the Tanana Valley, Interior Aids Association, the Regional Center for Alcohol and Other Addictions, and the Resource Center for Parents and Children.

Private Out Patient Clinics -- A variety of privately owned clinics serve FNSB residents with a full range of out-patient services and facilities including cancer detection, obstetrics, gynecology, pediatrics, orthopedics, holistic medicine, urgent care, chiropractics, physical therapy and sports medicine – including in some cases laboratory and radiology support services.

The Tanana Valley Clinic offers a full range of outpatient services.

Child Care Services -- The FNSB's Childcare Assistance Office administers public monies to assist area residents in meeting childcare needs. Funds are provided through the State of Alaska's Childhood Education and Early Development program and applicants must meet eligibility requirements.

The Child Care Development Fund is a federal and state funded block grant program based on family size and income. This grant is available for families in welfare-to-work programs and working families whose low income places them at risk. The Department of Health and Social Services is working in partnership to coordinate these funds with the state funded Day Care Assistance Program.

Family and Youth Services -- The Alaska State Division of Family and Youth Services (DFYS) has 30 field offices statewide, organized into four geographic management areas, with Fairbanks serving the interior region. The DFYS is responsible for protecting children from abuse or neglect and assisting in rehabilitating youth and assuring safety in the community when youth commit delinquent acts. In addition, a number of non-profits complement the public sector family and youth services provided by the State of Alaska.

Division of Medical Assistance -- The State of Alaska Division of Medical Assistance provides health coverage for Alaskans in need. The northern region office, serving the interior of Alaska, is located in Fairbanks. Services available include Medicaid program, chronic and acute medical assistance (CAMA), Healthy Baby and Healthy Kids program, home and community based care program, drug utilization review, Medicaid Management Information System (MMIS), surveillance and utilization review, and developmentally disabled (DD) individualized services.

Several other family and household assistance programs are also available through the State of Alaska including: Alaska Temporary Assistance Program (ATAP); welfare-to-work services; food stamp program; adult public assistance (APA); heating assistance program (HAP); and general relief assistance (GRA).

Education

FNSB School District -- The school district covers a 7,361-square mile area and serves approximately 15,800 students at 33 schools including elementary, middle and high schools, a vocational education center, a charter school, a correspondence program, and an alternative high school. Supplemental education is provided for children who are physically, emotionally or mentally handicapped, and for those who are gifted and talented. Schools range in size from a 1,500-student high school to a 76-student elementary school. The district-wide average class size is 24.3 students per class. The average Fairbanks student has higher composite SAT and ACT test scores than both state and national averages.

The local community supports Fairbanks public schools through school-business partnerships, school-aged tutoring programs, career day speakers, and by volunteering tens of thousands of hours to school-related activities.

The Alternative Learning System (ALS) consists of a Career Education Center, OPTIONS Teen Parenting Program, Correspondence, and Howard Luke Academy. Chinook Charter School serves K-8 students and New Beginnings Charter School serves junior and senior high school students affected by substance abuse.

The school district provides bus transportation for all students residing further than 1.5 miles away from their schools. It also transports students who are determined by the school board to live on “hazardous routes” for even shorter distances when conditions are unsafe for children to walk.

The FNSB School District receives funding from the borough, state and federal revenue sources. District finances are detailed in Section 3.16.4 earlier in this document. An elected seven-member school board is responsible for preparing the district budget, setting policy, new school design, and selecting the superintendent. The borough government's contribution to the school district's budget must be approved by the borough assembly. All school facilities are owned, built and maintained by the borough.

Public school enrollments have increased in step with population growth. As a result, many schools, particularly elementary schools, are at or near capacity.

Eight tuition-based religious or alternative schools are located in the greater Fairbanks area. Most have an enrollment of 100 to 150 students in grades K through 12, though two serve only grades 8 through 12 and are smaller. One large private Catholic school has an enrollment of 432 in grades K through 6, and another 213 in grades 7 through 12.

University of Alaska Fairbanks (UAF) -- The University of Alaska's main campus, UAF, is at College, near the City of Fairbanks. UAF is a land, sea and space-grant university, originally established in 1915 by. Congress and then called the Alaska Agricultural College. UAF serves 170 communities statewide through distance delivery of instruction, public service and research activities. UAF's new energy center lab for the study of renewable energy systems in remote locations opened in 1999.

Enrollment (fall 1999) was 8,250 students with 4874 female and 3376 male distribution. Eighty-seven percent of all enrolled students at UAF are Alaska residents.

Representing an annual payroll (1998) of more than $100 million, UAF is also the largest civilian employer in the Tanana Valley, with nearly 3,200 full and part-time faculty and staff, including 1,076 student workers.

Parks and Recreation

The FNSB and Recreation Department is responsible for developing and maintaining the borough's park system, its indoor recreational facilities, and for providing year-round recreational programs to meet the diverse needs of the community. With an annual budget in FY1999/2000 of $4.7 million (anticipated to be augmented in part through $1,057,280 in user fees), the department funds recreational programs for borough residents

Programs include aquatics, ice skating, therapeutic recreation, child safety, and youth at risk. The department also hosts and assists in the presentation of a number of special events. Facilities and programs are developed through a comprehensive plan that relies on community input and direction.

Recreational facilities include some combination of picnic areas/shelters, playgrounds, softball fields, boat launches, volleyball courts, basketball courts, soccer fields, swimming pools, BMX tracks, trails, camp sites, meeting rooms, showers and restrooms at approximately 66 sites.

The FNSB park and recreation facilities are located at various locations across the borough and are used by residents from all areas. Additional campgrounds and park facilities are owned and operated by the state and federal governments, accounting for an additional 380 camp sites. An additional twenty-five parks and campgrounds in the borough are privately owned and operated.

Libraries

The FNSB Public Library is a regional library serving individuals, families, and seniors within the FNSB. There are two locations in the borough – mid-town and the North Pole branches. Special children's programs, activities and story hours are also regularly provided by the library's children's department.

Families who live beyond the reach of the public library service may receive books, cassettes and other library materials through the mail. The FNSB Library also makes available a large auditorium seating 100 for public use and a conference room that can accommodate 30 people.

The Library Foundation is a non-profit organization that was formed to promote the general welfare of the FNSB's Public Library. The foundation's aim is to enhance public library service throughout the borough by financing supplemental programs and projects which the borough is unable to fund.

Public Safety

Generally, public safety services are provided for the residents within the city limits of Fairbanks and North Pole by each respective city government. People residing within the FNSB, but not within either city, rely on a combination of state funded, borough funded and volunteer services to meet their public safety needs.

Police -- Both the cities of Fairbanks and North Pole have their own police departments. The Fairbanks City Police Department currently has 6 senior officers and 27 patrol officers on staff. Officers are involved in both traditional law enforcement and active community involvement in long term planning for crime prevention. In addition, the City of Fairbanks has a community-policing program – Volunteers in Policing - which is staffed by volunteers and a funded program director. The primary focus of this program is to improve the safety and the profile of the central business district. Most of these Volunteers in Policing patrol on foot or bicycle.

The State of Alaska Correctional Facility is a pretrial close custody security facility that can accommodate 211 inmates. Occupancy rates in 1999 averaged 100%. Most frequently committed crimes were driving while intoxicated, domestic violence, assaults, larcenies and burglaries.

All borough residents outside of city limits rely on Alaska State Troopers for law enforcement and public safety protection. The Fairbanks trooper dispatch office is located near the intersection of Peger and Davis roads in mid-town. Three senior officers supervise 21 additional officers. State Department of Public Safety officials report that this staffing level is inadequate to respond to any reports other than life and property threats.

Fire Protection and Emergency Medical Services -- Both city governments provide fire protection and ambulance services. The Fairbanks Fire Department is staffed by 36 firefighters and 4 support staff who responded to 3,689 ambulance and fire emergency calls in 1999. The fire and police departments have been working together on centralized dispatch and enhanced 911 service.

Organized service areas administered through the FNSB Rural Services Division serve borough residents outside of city limits. For fire and emergency medical response purposes, the borough is served by a series of fire and rescue organizations.

- Chena Goldstream Ambulance Rescue Squad
- Chena Goldstream Fire Service Area
- Ester Fire Service Area
- North Star Fire Service Area
- Salcha Ambulance Rescue Squad
- Steese Fire Service Area
- University Fire Service Area

Equipment needs are met through the borough's administration of a non-areawide tax. The FNSB Emergency Management Division assists with the training and coordination of volunteers in the service areas.

Animal Control

The FNSB acknowledges an inordinately high number of pets and other animals among its residents from dog mushing teams to caribou farms to domestic cats. The borough is required by ordinance to protect residents from animals that become public nuisances or threats to public safety. Six trained personnel with five radio-dispatched vehicles staff the FNSB Division of Animal Control. Staff is based out of the FNSB Animal Shelter located mid-town and provides control for all domestic animals including livestock.

3.16.5.1.

Public Utilities

In 1997 the City of Fairbanks split up the Fairbanks Municipal Utilities System (FMUS) and sold the electric, water, sewer, steam heat and telephone utilities that service the community to the entities profiled below. All utilities in the FNSB continue to be certified and regulated by the Regulatory Commission of Alaska (RCA).

Electricity -- Golden Valley Electric Association (GVEA) is a nonprofit rural electric cooperative that provides service to approximately 90,000 Interior residents in the Fairbanks, Delta, Nenana, Healy and Cantwell areas at over 37,000 service locations. GVEA's peak system demand grew from 134.1 megawatts (MW) in 1996 to 175.5 MW in 1998 primarily as a result of adding FMUS's 6,000 customers to its system.

GVEA operates and maintains 2,250 miles of transmission and distribution lines and 33 substations. This system is interconnected with the Eielson AFB, Fort Wainwright, Fort Greely, the University of Alaska-Fairbanks and all electric utilities in the Railbelt. GVEA is the northern control point for the Fairbanks/Anchorage Intertie, which serves most Railbelt communities. The intertie augments GVEA's 224 MW generation capacity with an additional 70 MW. Their 224 MW generation capability is supplied by five generating facilities:

- The Healy plant provides 25 MW, is coal-fired, and is located at the back door of the Usibelli Coal Mine
- The 120 MW North Pole plant is oil-fired and built next to MAPCO's refinery
- The oil-fired Zehnder and Chena plants in Fairbanks can provide 36 MW and 23 MW, respectively,
- GVEA's 17% share of the energy (20 MW) from Bradley Lake's hydroelectric power plant is transmitted from Homer to the Interior via the intertie.

Electric rates in the FNSB have held steady since 1982. The electric cooperative attributes these savings to economic dispatching, favorable oil prices, the use of Bradley Lake hydroelectric power, the ability to purchase economic energy over the intertie and the additional revenue from the sale of energy to Fort Knox Gold Mine (which resulted in $28 million in fuel credits to members in 1998).

Water and Sewer -- Golden Heart Utilities (GHU) is rated by the Regulatory Commission of Alaska (RCA) as a Class A public water supplier and is owned by Fairbanks Sewer and Water, Inc. GHU provides water and wastewater service to approximately 6,000 locations and 33,000 residents. The water treatment plant was built in 1953, expanded in 1962, and again in 1990. It has a design capacity to treat 8 million gallons per day, currently operates at approximately 5 million gallons per day, and has a clear well capacity of 4.7 million gallons. The GHU Wastewater Treatment Plant treats the waste from the GHU service territory, the CUC service territory, and Fort Wainwright. The water is pumped from four wells along the Chena River.

College Utilities Corporation (CUC) provides water and sewer services to a 14-square mile area that lies generally to the west of the City of Fairbanks and includes the University of Alaska and the College community. Sewer customers number about 1,725 serving a population of over 15,000. All sewage is conveyed to the Golden Heart Utilities (GHU) Areawide wastewater treatment facility.

Water service is provided to more than 100 businesses and 10,000 residents in the community via approximately 1800 service connections. Each year water sales totaling 232 million gallons are distributed through 62 miles of transmission and distribution mains. Water is obtained from a series of wells (100 feet deep) located near CUC’s water treatment plant.

The current capacity of the treatment plant is 1.5 million gallons per day. The water is pumped into CUC’s water distribution and transmission main system, then elevated to a 1,000,000-gallon capacity reservoir located on Chena Ridge. This elevated storage supplies the system with water at 145 pounds per square inch

(PSI), resulting in a Class 4 Insurance Service Office (ISO) rating for superior fire flow through the system's 370 fire hydrants.

District Steam Heat -- Usibelli Coal Mine, Inc. (UCM) had provided fuel for domestic customers especially in Fairbanks and the Northern Railbelt for almost 50 years when it purchased the steam heat generating capacity of the coal fired FMUS Power Plant in 1997. Aurora Energy currently operates the district heat system in competition with other power providers. Aurora Energy has identified and aggressively pursued expansion opportunities for district heat in Fairbanks with the objective of increasing district heat sales, to increase thermal efficiency of plant, and reduce thermal discharge into the Chena River.

Natural Gas -- Natural gas is new to Fairbanks. When Fairbanks Natural Gas, LLC, the new natural gas utility announced it's intent to make this energy available to the Fairbanks market, developers of new properties began to work with FNG to lay appropriate distribution lines. Currently, natural gas is purchased and liquefied by Northern Eclipse, LLC at its liquefied natural gas (LNG) plant located at Point Mackenzie, Alaska. The LNG is then trucked to Fairbanks where it is returned to a gaseous state prior to introduction into the Fairbanks Natural Gas distribution system. Fairbanks Natural Gas currently serves 80 customers and has completed 3 construction seasons resulting in approximately 26 miles of buried distribution main spanning the south and west edges of the Fairbanks City Limits.

Telephone -- In 1997 PTI Communications moved its state-wide headquarters to Anchorage as a condition of its bid to purchase the FMUS telephone utility. PTI is owned by Alaska Communications Systems which provides full-service telecommunications to Fairbanks-area residents through PTI, PTI.net, MACtel, and ATU Long Distance. Additional long distance telephone and internet providers are AT&T Alascom and GCI. A variety of internet-only providers serve the Fairbanks market as well.

Solid Waste -- One landfill site serves the solid waste disposal needs of non-military FNSB residents. It is located .5 mile south of Fairbanks and is operated by FNSB Public Works and accepts and recycles vehicle batteries, scrap metal, aluminum, large household appliances, junk automobiles, waste paper. anti-freeze and household generated oil. The City of Fairbanks collects trash within the city limits and hauls it to the landfill site. The FNSB also operates 14 transfer sites around the borough to which borough residents who do not live within the city limits can haul their own household trash. The borough contracts with a private entity to haul trash from the transfer sites to the borough landfill. A second landfill is owned and operated by the US Army on Fort Wainwright and is used exclusively by post residents. The landfill on Fort Wainwright is in the process of being closed at which time solid waste will be sent to the FNSB landfill.

3.16.6 Economic Activity in the True North Study Area

Resource extraction is the primary economic activity within the True North project area. In fact, today as much as 80% of the mining activity in the FNSB is conducted in this sub-region which has been designated as "High Mineral Potential Land" in the FNSB Comprehensive Plan. FGMI owns the True North property as well as Fort Knox, the Steamboat, Westridge, Amanita, and Gil exploration properties in this area. Also active in this area, though on a smaller scale, are International Freegold, Polar Mining and the Corvette Group. Low market prices for gold have forced many placer miners who were once active in the area into inactive status at present.

Three residents operate businesses in the Cleary Summit area. One operates a year-round bed-and-breakfast with three rooms, each with private bath, and a separate kitchen and living room for late night aurora viewers. On an adjacent property, another resident operates a one room bed-and-breakfast unit on the lower floor of a single-family residence; this unit accommodates overflow from the neighboring property. A third resident owns five businesses on Cleary Summit:

- An electrical contracting company
- A downhill ski area with beginner-to-advanced slopes, a chairlift, a day lodge, a coffee shop, a gift shop, snow machine tours, equipment rentals

and lessons. The ski facility operates on weekends and holidays during daylight hours from November through April unless temperatures fall below –20 F degrees, and by appointment. This facility is available for rent during the summer months for events.

- A mining-camp-style bunkhouse with 18 rooms, 9 baths, a restaurant with liquor license, and a large lobby and deck for aurora viewing. During the 1999 calendar year the operator of this facility recorded 715 customers. First quarter comparisons for 1999 and 2000 show occupancy rates holding steady.
- A dog sled ride business with the requisite dog yard selling rides primarily to tourists.
- A snow machine tour company that provides both equipment rentals and guided tours for visitors to the area.

Two of the businesses on Cleary Summit complement their primary economic activity with retail sales of Alaska gifts and souvenirs to their tourism clients.

The bunkhouse, the ski lodge and the bed-and-breakfasts are aurora viewing destinations for overnight guests at Cleary Summit and two lodges further north on the Steese Highway, as well as for “day” trip clients from hotels in Fairbanks. These clients generally arrive at Cleary Summit by bus around 10:00 p.m., wait at the ski lodge or bunkhouse, and then view the aurora from the parking lot of the ski lodge. Many of the transient clients are part of tour groups operated by an estimated 8 tour companies, most of which have a base of operations in Fairbanks. For the 1999 calendar year, lodge owner sales records show a total of 4,698 aurora viewing customers, 46 of which were independent visitors as opposed to part of an organized tour. The bed-and-breakfast owner sales records for the same period show 375 room rental nights; with an average of two occupants per room per night, the estimated total number of aurora-viewing-night customers at Cleary Summit in 1999 is 5,448. While total figures for 2000 are not yet available, it is significant that available figures for first quarter lodge occupancy comparisons between 1999 and 2000 show a 13% increase in sales for the year 2000.

No comprehensive regional visitation-over-time trend analyses have been completed on Japanese visitation in interior Alaska. The Fairbanks Convention and Visitors Bureau (FCVB) does request that those visitors who enter the log cabin visitor center downtown sign in indicating their state or country of origin. The FCVB compiles these statistics in a format which indicates the top three states and the top three countries of origin by month. While these figures have been collected in this manner since 1994, FCVB staff are quick to point out that 1) not all visitors to Fairbanks visit the log cabin visitor center, or 2) not all visitors who enter the log cabin take the time to sign in. Thus, these statistics are extrapolative at best, but it is telling to note that the figures collected confirm that of the foreign visitors coming to Fairbanks from October through March, the Japanese visitors have increased proportionately from 1994 to 1997 until 1998 and 1999 where they have dominated these winter tourism months.

In addition, Dr. Laura Millner at the University of Alaska School of Business is scheduled to complete a visitation trends analysis of Japanese winter visitors later in the year 2000. To date her studies of this visitor sector have characterized the Japanese winter visitor in terms of trip purpose, expectations, lodging preferences and expenditures. Notably, Milner's 1998 Japanese Winter Visitor Profile Survey study included a survey of 84 Japanese visitors which indicated that their contribution to the Fairbanks winter economy per capita averaged $523.60. Millner notes that of the 84 visitors surveyed:

- 50% spent some money on retail goods
- 55% spent some on groceries and snacks
- 39% spent money in restaurants and bars
- 48% spent money to purchase tours and attractions, and
- 14% spent money on additional transportation

These expenditures are in addition to the accommodations and lodging that are purchased by the overwhelming majority of Japanese tourists through package tour operators in Japan. This income and its accompanying multiplier effect, while not relatively significant compared to other industrial sectors in interior Alaska, is a welcome addition to a wintertime economy that is significantly slower than its spring, summer and fall quarters.

Millner's survey respondents consistently and overwhelmingly listed viewing of the northern lights as the single most important purpose of their Fairbanks trip. In addition, they cited the aurora viewing opportunities as the differentiator when queried as to why they chose the Fairbanks market. Specifically, when asked "Why did you choose the Fairbanks area for this trip rather than other Alaskan destinations?" Specifically, they selected Fairbanks as a winter destination because of:

- northern lights (36%)
- schedule and time limitations (27%)
- price (15%)
- seasonal considerations (9%)
- competing package tour limitations (6%)
- desire to ride Alaska railroad (3%)
- can ski in Japan as well as Alyeska (3%)
- road problems elsewhere (3%)

It is significant to note that the 2000-2001 winter and the 2001-2002 winter have been projected by the University of Alaska Geophysical Institute, and confirmed by its international counterparts, as peak years for aurora viewing. This is a period when sun spot minimums will make the aurora more visible everywhere, but especially in those locations which are closer to the equator and normally to do not have clearly evident aurora. Correspondingly, international tour packagers and Alaska tourism marketing entities include in 1999 through 2002 marketing programs and plans promotional campaigns that include this information. It is anticipated that the increased aurora viewing opportunities, coupled with the complementary marketing, will significantly increase winter visitation in Interior Alaska.

Experts at the Geophysical Institute cite the following locations around Fairbanks as having the best available viewing conditions: Cleary Summit, Ester Dome Summit, Murphy Dome, and the hilltop on the Elliot Highway just north of Fox. The Institute's Dr. Charles Deehr describes the ideal aurora viewing site as one which has "a good, wide view of the northern horizon on a moonless, cloudless night between 10PM and 2AM."

The overall change in assessed values for the Cleary Summit Subdivision from 1989 through 1994 showed an increase of 11percent, a straight line increase of 2 percent per year. The time period from 1994 through 1999 for the same properties indicated an increase of 21.73 percent, with an average 4.96 percent per year increase. The overall change in assessed values for the Skiland Subdivision from 1989 through 1994 showed an increase of 4.17 percent, an average increase on a straight line basis of .83 percent per year. The time period from 1994 through 1999 for the same properties indicated an overall increase of 23.23 percent, with an average increase of 4.65 percent per year (Hage & Associates, 2000).

The data shows a fairly consistent pattern for both subdivisions in the 1994 through 1999 period. In reviewing the "Economic Indicators" as outline in the Fairbanks Community Research Quarterly, Summer 2000 edition, the changes in the assessed values of properties in the overall FNSB indicate an average increase of 2.2 percent per year in property assessment in the period from 1989 through 1994 and an average increase of 6.16 percent per year from 1994 through 1998 (Hage & Assoc., 2000).

3.17 LAND USE

This discussion of land use in the True North project area has been taken largely from Mining Public Consent (2000a). That document contains additional information and pictures of many of the uses described below.

In the State's Tanana Basin Area Plan, the True North project area is in management Unit 1-J. Most of the project area falls under subclassification 1J2, which designates the following primary land uses: minerals and public recreation. Land disposals and remote cabins are prohibited within 1J2. The minor Cleary Summit-Pedro area falls under subclassification 1J1, which designates the primary land use as settlement; secondary surface uses are public recreation and wildlife habitat. Remote cabins are prohibited.

The True North project falls under two designations in the FNSB Comprehensive Plan, a combination of "High Mineral Potential," and "Reserve Area." The latter designation means uses such as mining, agriculture, recreation, hunting, trapping and fishing are all permitted until such time as a more specific highest and best use is identified.

Mineral activities have dominated land use in the immediate vicinity of the proposed True North Mine, and have produced the greatest visible impact to surface features. Other transitory land uses have included hiking, biking, berry picking, cross country skiing, snowmachining, mushing, horseback riding, trapping and small/large game hunting.

Permanent land uses in the True North project area discussed below have been classified according to the American Planning Association's (APA) Land Based Classification Standards (LBCS) adopted officially by the APA in October 1999. Table 3.17-1 presents the LBCS activity classification.

Table 3.17-1
American Planning Association (APA) Land Based Classification Standards

LBCS Code	Land Use Activity
1000	Residential
2000	Shopping, business or trade
3000	Industrial, manufacturing, or waste-related
4000	Social, institutional, or infrastructure-related
5000	Travel or movement activities
6000	Mass assembly of people
7000	Leisure activities
8000	Natural resource-related activities
9000	No human activity or unclassifiable
Source:	American Planning Association, LBCS Code, October 1999